

TWO ORCHESTRAL WORKS: RESURRECTION & DELUGE,
INSPIRED BY TWO PAINTINGS OF VASILY KANDINSKY

Part I

A Dissertation

Presented to the Faculty of the Graduate School
of Cornell University

In Partial Fulfillment of the Requirements for the Degree of
Doctor of Musical Arts

by

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TWO ORCHESTRAL WORKS: RESURRECTION & DELUGE,
INSPIRED BY TWO PAINTINGS OF VASILY KANDINSKY

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Cornell University 2010

The title “*Resurrection*” is adapted from the subtitle of a painting by Vassily Kandinsky, “Composition V-Resurrection,” which became the inspiration for the musical structure and expression of the piece. With the assistance of some computer analysis applications, I am able to draw closer the relationship of the structure of the painting with the pitch and time structure of the music. There are two continuous movements. The first utilizes mainly Western techniques, which are concentrated on the dialogues between the clarinet and the orchestra with an active and mostly dense orchestration; the second part is focused on the clarinet solo accompanied by various sounds that are blended with the electronics and the orchestra. This work was commissioned by the American Composers Orchestra and premiered by soloist Derek Bermel on the clarinet with ACO under the baton of George Manahan at Carnegie-Zankel Hall in New York City on February 20, 2009.

Deluge adopted the title of Kandinsky’s painting *Composition VI-Deluge* and was inspired by the color, form, and expression of the painting. According to Kandinsky, “in this picture one can see two centers: On the left, the delicate, rosy, somewhat blurred center, with weak, indefinite lines in the middle; on the right (somewhat higher than the left). The crude, red-blue, rather discordant area, with sharp, rather evil, strong, very precise lines. Between these two centers is a third (nearer to the left), which one only recognizes subsequently as being a center, but is, in the end, the

principal center.” The structure of the music is based on this form, where the third section of the piece serves as the main movement, transforming an ancient Gu Qin piece “Flowing Water” to be played by the harp. As the title *Deluge* suggests, it associates with water and disasters. This piece was commissioned by Esa-Pekka Salonen and Los Angeles Philharmonic Association.

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Resurrection 重生

*for Clarinet and Chamber Orchestra with Live
Electronics*

FANG Man (2008-9)

This work is composed in 2008, commissioned by Mr. Underwood and the American Composers Orchestra, and premiered by Clarinetist Derek Bermel, and George Manahan conducting ACO at Zankel-Carnegie Hall, New York on February 20, 2009

The creation and realization of the live electronics thanks to the assistant and tools designed by sound engineer Alexis Baskind

Instrumentation:

****Clarinet Solo***

**1 Flute doubling Piccolo; 1 Oboe;
1 Bass Clarinet; 1 Bassoon dbl Contrabassoon;
1 French Horn; 1 Trumpet in C; 1 Trombone, 1 Tuba;
Percussion; Harp, Piano dbl Celesta; Strings (6-5-4-3-2)*

****Percussion: (3 players)***

*I: Susp. Cymbal; Sand Blocks; Mouth Siren; Flexatone; 2 Congas;
Crotale; Chimes; Glockenspiel;
Xylophone (f to c4); Tambourine; Castanets; Claves; Chinese
Clapper Drum;
Chinese Small Gong; Large Crash Cymbal*

*II: Susp. Cymbal; Sand Blocks; Mouth Siren; 4 Wood-Blocks; 4
Tom-Toms; Vibraphone (f to c4);
Mark Tree; Triangle; Medium Tam Tam; Chinese Small Cymbal*

*III: Susp. Cymbal; Mouth Siren; Wood Chimes; 5 Temple-Blocks;
Snare Drum; Maracas; Crotale;*

Performance Notes:

*This score is written at actual sounding pitch except Piccolo,
Contrabassoon, Celesta, Glockenspiel, Xylophone,
Crotale, and Double Bass.*

Duration: ca. 18 minutes

"Colour is a power which directly influences the soul. Colour is the keyboard, the eyes are the hammers, the soul is the piano with many strings. The Artist is the hand which plays, touching one key or another, to cause vibrations in soul."

Vasily Kandinsky (1866-1944)

Inspired by a Painting of Vasily Kandinsky

Composition V: "Resurrection of the Dead" (1911)



To Derek, George and ACO

Resurrection

for Clarinet and Chamber Orchestra with Live Electronics

Fang Man
(2008)

Event 1 $\text{♩} = 44$

air breath

Flute/ Piccolo
Oboe
Bass Clarinet
Contrabassoon/
Bassoon
Horn in F
Trumpet in C
Trombone
Tuba
Percussion 1 [Susp. Cymbal] with wire brushes
Percussion 2 [Susp. Cymbal] with wire brushes
Percussion 3 [Susp. Cymbal] with wire brushes
Harp
Piano
Piano/
Celesta
Violin I I
Violin I 2
Violin I 3
Violin II I
Violin II 2
Viola I
Viola 2
Violoncello I
Contrabass I

[Granular+Random Delay+Spat]

div. a 3
div. a 2
div. a 2
mix.
mix.

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Event 2

div. a 2

Event 5

C $\text{♩} = 44$

19

Fl./Pic.

Ob.

B. Cl.

C. Bsn./
Bsn.

Hn.

C. Tpt.

Tbn.

Tuba

Perc. 1

Perc. 2

Perc. 3

Large Tam Tam

mp

19

Hp.

bishighlands

8^{va} - 7^{va} *ppp*

8^{va} - 7^{va} *pp*

8^{va} - 7^{va} *pp*

8^{va} - 7^{va} *pp*

19

Pao.

C $\text{♩} = 44$

19

Clar. S.

(air noise)

ppp

flaut

8^{va} - 7^{va} *mf*

8^{va} - 7^{va} *fp*

8^{va} - 7^{va} *mf*

8^{va} - 7^{va} *mf*

8^{va} - 7^{va} *mp*

8^{va} - 7^{va} *mf*

8^{va} - 7^{va} *mp*

8^{va} - 7^{va} *fp*

8^{va} - 7^{va} *fp*

air breath

air bréailh' (Key clicks)

19

Vln. I I

Vln. II I

Vln. I

Vc. I

Ch. I

Event 6

[illegible]

Event 7

D

31

accel.

♩=108

11

Even

This page of a musical score is for a percussion ensemble, featuring multiple staves with complex rhythmic patterns and dynamic markings. The score is written in 4/4 time and includes various percussion instruments, including snare drums, tom-toms, and cymbals. The dynamics range from *pp* (pianissimo) to *ff* (fortissimo), with intermediate markings like *fz* (forzando) and *mf* (mezzo-forte). The score is divided into measures, with some measures containing multiple rhythmic patterns. The page includes a variety of musical notation, including eighth notes, sixteenth notes, and rests. The score is written in a standard musical notation style, with a key signature of one flat (B-flat) and a common time signature of 4/4. The page is numbered 36 in the top left corner. The score is written in a standard musical notation style, with a key signature of one flat (B-flat) and a common time signature of 4/4. The page is numbered 36 in the top left corner.

13

14

F ♩ = 80

15

16

Event 13

H. Picc.		$\frac{2}{4}$
Ob.		$\frac{2}{4}$
B. Cl.		$\frac{2}{4}$
C. Ban./ Ban.		$\frac{2}{4}$
Hr.		$\frac{2}{4}$
C. Tpt.		$\frac{2}{4}$
Tbn.		$\frac{2}{4}$
Taba		$\frac{2}{4}$
Perc. 1		$\frac{2}{4}$
Perc. 2		$\frac{2}{4}$
Perc. 3		$\frac{2}{4}$
Hp.		$\frac{2}{4}$
Pao.		$\frac{2}{4}$
Chr. S.		$\frac{2}{4}$
Vln. I 1		$\frac{2}{4}$
Vln. I 2		$\frac{2}{4}$
Vln. I 3		$\frac{2}{4}$
Vln. II 1		$\frac{2}{4}$
Vln. II 2		$\frac{2}{4}$
Vln. 1		$\frac{2}{4}$
Vln. 2		$\frac{2}{4}$
Vc. 1		$\frac{2}{4}$
Ch. 1		$\frac{2}{4}$

Electronics 13 secs.
wait until finish

18

Fl.Picc. *f* *sf* *p* *pp* *sf* *f* *sf*
 Ob. *f* *sf* *p* *pp* *sf* *f* *sf*
 B. Cl. *p* *pp* *ppp* *sf* *f* *sf*
 C.Bsn./Bsn. *p* *pp* *ppp* *sf* *f* *sf*
 Hr. *pp* *ppp* *sf* *f* *sf*
 C.Tpt. *pp* *ppp* *sf* *f* *sf*
 Tbn. *pp* *ppp* *sf* *f* *sf*
 Tuba *pp* *ppp* *sf* *f* *sf*
 Perc. 1 *f* *sf* *sf* *sf* *sf* *sf*
 Perc. 2 *mp* *sf* *fp* *pp* *mp* *sf* *sf* *sf*
 Perc. 3 *f* *sf* *f* *sf* *f* *sf* *sf*
 Hp. *mp* *p* *f* *f* *f* *f*
 Pno.Cel. *mp* *p* *sf* *f* *sf* *sf*
 Clac.S. *mp* *p* *pp* *f* *sf* *sf*
 Vln. I.1 *con ond.* *f* *sf* *mp* *pp* *p* *pp* *sf* *f* *sf*
 Vln. I.2 *sf* *sf* *mp* *pp* *p* *pp* *sf* *f* *sf*
 Vln. II.1 *sf* *sf* *mp* *pp* *p* *pp* *sf* *f* *sf*
 Vln. II.2 *sf* *sf* *mp* *pp* *p* *pp* *sf* *f* *sf*
 Vla. 1 *sf* *sf* *mp* *pp* *p* *pp* *sf* *f* *sf*
 Vla. 2 *sf* *sf* *mp* *pp* *p* *pp* *sf* *f* *sf*
 Vc. 1 *sf* *sf* *mp* *pp* *p* *pp* *sf* *f* *sf*
 Ch. 1 *sf* *sf* *mp* *pp* *p* *pp* *sf* *f* *sf*

21

I Poco Più mosso

[illegible]

90 **J** $\text{♩} = 132$

Fl/Pic. *mp* *mf*

Ob. *p* *mp* *mf*

B. Cl. *mp* *mf*

C. Bsn./Bsn. *f* *f* *f*

Hr. *p* *Solo* *mf*

C. Tpt. *mf*

Tbn. *p*

Tuba

Perc. 1 *pp* *mf* *p*

Perc. 2 *p* *mf* *mf* *4 Tom-toms*

Perc. 3 *pp* *subito mp* *mf*

Hp. *f* *mp* *mf* *f* *f*

Pno. *mf* *p*

Clar. S. **J** $\text{♩} = 132$

Vln. I 1 *mp* *p* *mp* *mf*

Vln. I 2 *mp* *p* *mp* *mf*

Vln. I 3 *mp*

Vln. II 1 *f* *p* *mp* *mf*

Vln. II 2 *f* *p* *mp* *mf*

Vln. 1 *f* *p* *mp* *mf*

Vln. 2 *f* *p* *mp* *mf*

Vc. 1 *p* *p* *mp* *mf*

Ch. 1 *f* *f* *f* *f*

Ch. 2 *f*

110 L ♩ = 126

Fl./Pic. *p* *ff* *mp*

Ob. *p* *ff* *mp*

B. Cl. *p* *ff* *mp*

C. Bas. / Bas. *ff* *mp* *mf*

Hr. *pp* *f* *mp*

C. Trp. *pp* *f* *mp*

Tbn. *pp* *f* *mp* *Solo*

Tuba *pp* *f* *mp* *Solo*

Perc. 1 *f*

Perc. 2 *mp* *mf*

Perc. 3 *p* *mp* *mf* *f*

Hp. *ff* *mf*

Cel. *mf* Celesta *mf*

Chr. S. *f* *mf*

Vln. I. 1 *mf* *f* *ff* *mp* *mp* *mp*

Vln. I. 2 *mf* *f* *ff* *mp* *mp* *mp*

Vln. I. 3 *mf* *f* *ff* *mp* *mp* *mf*

Vln. II. 1 *mf* *f* *ff* *mp* *mp* *mf*

Vln. II. 2 *mf* *f* *ff* *mp* *mp* *mf*

Vln. 1 *ff* *mf* *mf*

Vln. 2 *ff*

Vcl. *mf* *mf* *mf* *div. a 2*

Ch. 1 *ff* *mp* *mf*

29

M

poco a poco rit.

Fl./Picc. *pp*

Ob. *pp*

B. Cl. *pp*

C. Bas./
Bsn. *pp*

Hr. *p* *con sord.* *pp*

C. Trp. *p* *pp*

Tbn. *p* *con sord.* *pp*

Tuba *p* *con sord.* *pp*

Perc. 1

Perc. 2 *mp* *Molium Tam Tam*

Perc. 3 *mp* *Susp. Cymbal*

Hrp. *mp*

Pno. *p*

Chr. S. *mf* *mp* *p* *mp*

Vln. I *pp* *sf* *piz.* *acc.* *p*

Vln. II *pp* *sf* *piz.* *acc.* *p*

Vla. *piz.* *div. a 2* *mp* *p*

Vcl. *div. a 2* *con sord.* *pp* *piz.* *acc.* *p*

Vcl. *div. a 2* *con sord.* *pp* *piz.* *acc.* *p*

Ch. 1

2/4

N ♩ = 66

33

34

35

Event 16

Instrument List:

- Fl. Picc.
- Ob.
- B. Cl.
- C. Bass./Bar.
- Hr.
- C. Tpt.
- Tbn.
- Tuba
- Perc. 1
- Perc. 2
- Perc. 3
- Hp.
- Cel.
- Clar. B.
- Vln. I
- Vln. II
- Vla. I
- Vla. II
- Vcl. I
- Vcl. II
- Ch. I

Key Musical Elements:

- Measures 150-154:** The score spans five measures.
- Measures 150-151:** Flute/Piccolo and Oboe have a *Solo* section. Oboe dynamics are *p*, *mp*, and *pp*.
- Measure 152:** Tuba has an *espressivo! Solo* section starting with *p*.
- Measures 153-154:** Percussion 3 has a *subglissando* section. Harp and Cello have *pp* dynamics.
- Violin I:** Starts with *sf* and *sf* accents, then *p* and *mp* dynamics.
- Violoncello I:** Starts with *p*, then *mp* and *pp* dynamics.

Event 18

Q = 132

Fl. Pic. *mp*

Ob. *mf*

B. Cl. *mp*

C. Bass./Bsn. *mp*

Hr. *p*
senza sord.

C. Trp. *p*

Tbn. *ppp*

Tuba *p*

Perc. 1 *mf*

Perc. 2 *mf*
Vln. with wire brushes
enter on pedal depressed

Perc. 3 *mp*

Hp. *mp*

Cel. *p*
Celesta

Clar. S. *f*

Vln. I 1 *mp*

Vln. I 2 *mp*

Vln. II 1 *mp*
senza sord.

Vln. II 2 *mp*
senza sord.

Vln. 1 *mp*
a2
pin.

Vln. 2 *mp*
pin.

Vc. 1 *mp*
pin.

Cb. 1 *mp*

39

40

41

42

T $\text{♩} = 104$

Fl/Pic. *mp* *mf* *mf* *mp* *mf* *pp*

Ob. *mp* *mf* *mp* *mf* *mf* *pp*

B. Cl. *mp* *mf* *mp* *mf* *mf* *pp*

C. Bsn./Bsn. *mp* *mf* *mp* *mf* *mf* *pp*

Hr. *mp* *mf* *Solo* *mp* *mf* *mf*

C. Tpt. *mp* *mf* *Solo* *mp* *mf* *mf*

Tbn. *mp* *mf* *Solo* *mp* *mf* *mf*

Tuba *mp* *mf* *Solo* *mp* *mf* *mf*

Perc. 1 *mp* *mf* *mp* *mf* *mf* *pp*

Perc. 2 *mp* *mf* *mp* *mf* *mf* *pp*

Perc. 3 *mp* *mf* *mp* *mf* *mf* *pp*

Hp. *mp* *mf* *mp* *mf* *mf* *pp*

Cel. *mp* *mf* *mp* *mf* *mf* *pp*

Clar. S. *mp* *mf* *mp* *mf* *mf* *pp*

Vln. I. *mp* *mf* *mp* *mf* *mf* *pp*

Vln. II. *mp* *mf* *mp* *mf* *mf* *pp*

Vcl. *mp* *mf* *mp* *mf* *mf* *pp*

Ch. *mp* *mf* *mp* *mf* *mf* *pp*

T $\text{♩} = 104$

▼
Event 19

189

Fl/Picc. $\frac{2}{4}$

Ob. $\frac{2}{4}$

B. Cl. $\frac{2}{4}$

C. Bass /
Bass. $\frac{2}{4}$
pp

Hr. $\frac{2}{4}$
189

C. Tpt. $\frac{2}{4}$

Tru. $\frac{2}{4}$

Tuba $\frac{2}{4}$

Perc. 1 $\frac{2}{4}$

Perc. 2 $\frac{2}{4}$
mp

Perc. 3 $\frac{2}{4}$

Hp. $\frac{2}{4}$
mp

Cel. $\frac{2}{4}$
p

Clar. S. $\frac{2}{4}$
mf
expressed

Vln. I $\frac{2}{4}$
mp
unb.

Vln. II $\frac{2}{4}$
mp
unb.

Vla. I $\frac{2}{4}$
p
unb.
expressed

Vc. I $\frac{2}{4}$
p
expressed

Ch. I $\frac{2}{4}$
p
expressed

Event 20

Full score page 45, titled "Event 20". The score is for a large orchestra and includes the following parts:

- Flute/Piccolo (Fl/Pic):** Part 1, measures 1-4.
- Oboe (Ob.):** Part 1, measures 1-4.
- Bassoon/Clarinet in B-flat (B. Cl.):** Part 1, measures 1-4.
- Contrabassoon/Bass (C. Bass/Bas.):** Part 1, measures 1-4.
- Horn (Hr.):** Part 1, measures 1-4.
- Trumpet (C. Trp.):** Part 1, measures 1-4.
- Trombone (Tbn.):** Part 1, measures 1-4.
- Tuba (Tuba):** Part 1, measures 1-4.
- Snare Drum (Perc. 1):** Part 1, measures 1-4.
- Cymbal (Perc. 2):** Part 1, measures 1-4.
- Tom (Perc. 3):** Part 1, measures 1-4.
- Harpsichord (Hp.):** Part 1, measures 1-4.
- Cello (Cel.):** Part 1, measures 1-4.
- Clarinet in E-flat (Clar. S.):** Part 1, measures 1-4.
- Violin I (Vln. I):** Part 1, measures 1-4.
- Violin II (Vln. II):** Part 1, measures 1-4.
- Viola (Vla.):** Part 1, measures 1-4.
- Violoncello (Vcl.):** Part 1, measures 1-4.
- Double Bass (Cb.):** Part 1, measures 1-4.

The score is written in 4/4 time and features a variety of musical notations, including dynamics (e.g., *mf*, *pp*, *p*, *ppp*), articulation (e.g., *acc.*, *stacc.*), and performance instructions (e.g., "Susp. Cymbal", "con sord."). The page number 45 is centered at the bottom.

U $\text{♩} = 132$

Fl/Picc. *mp*

Ob. *mp*

B. Cl. *mp*

C. Bsn./Bsn. *Solo. mp*

Hr. *mf*

C. Tpt. *Solo. mp*

Trbn. *mp*

Tuba *mp*

Perc. 1 *p* *mp* *p* *mp*

Perc. 2 *p* *mp* *mf* *4 Tom toms*

Perc. 3 *mp* *p* *mp* *mf*

Hr. *mf*

Piano *mp*

Clav. S. *mf*

Vln. I. 1 *mp*

Vln. I. 2 *mp* *con sord.*

Vln. I. 3 *pizz. mp*

Vln. II. 1 *mp* *con sord.*

Vln. II. 2 *mp* *con sord.*

Vln. II. 3 *pizz. mp*

Vln. 1 *mp* *con sord.*

Vln. 2 *mp* *con sord.*

Vln. 3 *pizz. mp*

Vc. 1 *pizz. mf*

Ch. 1 *pizz. mf*

V

V

AA

The image displays a page from a musical score, likely for a symphony. The score is written for a large ensemble, including various woodwinds, strings, and percussion. The instruments listed on the left include Piccolo, Oboe, Clarinet, Violin (I, II, III, IV, V, VI), Viola (I, II, III, IV, V), Cello/Double Bass, and various percussion instruments like Chinese Chopper Drum, Small Chinese Cymbals, and Chinese Opera Gong. The score is written in 4/4 time, with a key signature of one flat (B-flat). The tempo is marked as ♩ = 88. The score includes various musical notations such as notes, rests, dynamics (ppp, p, mp, mf, f), articulation (accents, slurs), and performance instructions (e.g., "con sord.", "cresc. var. sord.", "cresc. var. sord. con sord."). There are also some specific markings like "Piccolo" and "Chinese Chopper Drum" in boxes. The score is divided into measures, with some measures containing multiple staves for different instruments. The overall layout is professional and detailed, typical of a high-quality musical score.

Event 28

[illegible]

Event 29

BB

FL/Picc. *pp* *mp* *p*

Ob. *pp*

B. Cl. *p* *mp* *p* *pp* *mp* *p*

C. Bsn./Bsn. *p* *mp* *p* *pp* *mp* *p*

Hr. *mf* *pp* *mp* *p*

C. Tpt. *mf* *pp* *mp* *p*

Tbn. *pp* *mp* *p*

Perc. 1 *mf* [Chinese Opera Gong (Small)]

Perc. 2 *mf*

Perc. 3 *mf*

Hr. *mp*

Picc. *p* *mp*

Clar. S. *mp* (Warlord Chen) (Marshall Zhang)

Vln. I 1 *p* *mp* *p* *pp*

Vln. I 2 *p* *mp* *p* *pp*

Vln. II 1 *p* *mp* *p* *pp*

Vln. II 2 *p* *mp* *p* *pp*

Vla. 1 *p* *mp* *p* *pp*

Vla. 2 *p* *mp* *p* *pp*

Vc. 1 *pp* *p*

Event 30

CC

260

Fl/Picc. *pp*

Ob. *pp*

B. Cl. *pp*

C. Bass. *pp*

Hr. *pp*

C. Tpt. *pp*

Tbn. *pp*

Tuba *pp*

Perc. 1 *mf*

Perc. 2 *mf*

Perc. 3 *mf*

Hr. *mf*

Pan. *mf*

Chr. S. (Wardell Chen) *mf*

(Mandai Zhang) *mf*

Vla. 1 *mf*

Vla. 2 *mf*

Vla. 3 *mf*

Vla. 4 *mf*

Vla. 5 *mf*

Vla. 6 *mf*

Vla. 7 *mf*

Vla. 8 *mf*

Vla. 9 *mf*

Vla. 10 *mf*

Vla. 11 *mf*

Vla. 12 *mf*

Vla. 13 *mf*

Vla. 14 *mf*

Vla. 15 *mf*

Vla. 16 *mf*

Vla. 17 *mf*

Vla. 18 *mf*

Vla. 19 *mf*

Vla. 20 *mf*

Vla. 21 *mf*

Vla. 22 *mf*

Vla. 23 *mf*

Vla. 24 *mf*

Vla. 25 *mf*

Vla. 26 *mf*

Vla. 27 *mf*

Vla. 28 *mf*

Vla. 29 *mf*

Vla. 30 *mf*

Vla. 31 *mf*

Vla. 32 *mf*

Vla. 33 *mf*

Vla. 34 *mf*

Vla. 35 *mf*

Vla. 36 *mf*

Vla. 37 *mf*

Vla. 38 *mf*

Vla. 39 *mf*

Vla. 40 *mf*

Vla. 41 *mf*

Vla. 42 *mf*

Vla. 43 *mf*

Vla. 44 *mf*

Vla. 45 *mf*

Vla. 46 *mf*

Vla. 47 *mf*

Vla. 48 *mf*

Vla. 49 *mf*

Vla. 50 *mf*

Vla. 51 *mf*

Vla. 52 *mf*

Vla. 53 *mf*

Vla. 54 *mf*

Vla. 55 *mf*

Vla. 56 *mf*

Vla. 57 *mf*

Vla. 58 *mf*

Vla. 59 *mf*

Vla. 60 *mf*

Vla. 61 *mf*

Vla. 62 *mf*

Vla. 63 *mf*

Vla. 64 *mf*

Vla. 65 *mf*

Vla. 66 *mf*

Vla. 67 *mf*

Vla. 68 *mf*

Vla. 69 *mf*

Vla. 70 *mf*

Vla. 71 *mf*

Vla. 72 *mf*

Vla. 73 *mf*

Vla. 74 *mf*

Vla. 75 *mf*

Vla. 76 *mf*

Vla. 77 *mf*

Vla. 78 *mf*

Vla. 79 *mf*

Vla. 80 *mf*

Vla. 81 *mf*

Vla. 82 *mf*

Vla. 83 *mf*

Vla. 84 *mf*

Vla. 85 *mf*

Vla. 86 *mf*

Vla. 87 *mf*

Vla. 88 *mf*

Vla. 89 *mf*

Vla. 90 *mf*

Vla. 91 *mf*

Vla. 92 *mf*

Vla. 93 *mf*

Vla. 94 *mf*

Vla. 95 *mf*

Vla. 96 *mf*

Vla. 97 *mf*

Vla. 98 *mf*

Vla. 99 *mf*

Vla. 100 *mf*

Ch. 1 *mf*

Ch. 2 *mf*

DD

[illegible]

Event 32

FL/Psec.

EE

58

Event 34

The musical score for Event 34 is a complex orchestral and piano arrangement. It begins with a 29-measure rest for the Piano/Conductor. The score is divided into two main sections by a double bar line. The first section features a variety of instruments including woodwinds, brass, and strings, with dynamics ranging from *pp* to *f*. The second section, starting at measure 30, includes a piano part with a melodic line and a bass line, as well as a woodwind section with specific articulations like 'con sord. (straight)'. The score concludes with a 32-measure rest for the Piano/Conductor.

Instrument List:

- Fl. Picc.
- Ob.
- B. Cl.
- C. Ang./Bsn.
- Hr.
- C. Trp.
- Tbn.
- Tuba
- Perc. 1
- Perc. 2
- Perc. 3
- Hrp.
- Pno/Con.
- Clar. B.
- Vln. I
- Vln. II
- Vln. III
- Vln. IV
- Vln. V
- Vln. VI
- Vln. VII
- Vln. VIII
- Vln. IX
- Vln. X
- Vln. XI
- Vln. XII
- Vln. XIII
- Vln. XIV
- Vln. XV
- Vln. XVI
- Vln. XVII
- Vln. XVIII
- Vln. XIX
- Vln. XX
- Vln. XXI
- Vln. XXII
- Vln. XXIII
- Vln. XXIV
- Vln. XXV
- Vln. XXVI
- Vln. XXVII
- Vln. XXVIII
- Vln. XXIX
- Vln. XXX

Dynamic Markings: *pp*, *mp*, *f*, *ff*, *con sord. (straight)*, *Piano*.

Articulations: *con sord. (straight)*, *Piano*.

Event 34

FF

(Warlord Chen)

A musical score for a single melodic line. It begins with a treble clef and a key signature of one sharp (F#). The melody consists of several eighth and sixteenth notes, with some notes beamed together. There are some markings below the staff, possibly indicating fingerings or breath marks.

GG

GO

The image displays a page from a musical score, specifically for "Event 38". The score is written for a large ensemble, including woodwinds, strings, and a soloist. The instruments listed on the left are Flute/Piccolo, Oboe, Bassoon, Clarinet, Violin I, Violin II, Viola, Cello, and Double Bass. The score is in 4/4 time and features a variety of dynamic markings, including piano (p), mezzo-piano (mp), mezzo-forte (mf), and forte (f). A section of the score is highlighted with a box and labeled "Event 38". The music is written in a standard musical notation style, with staves for each instrument and a common key signature of one flat (B-flat). The score includes various musical notations such as notes, rests, and dynamic markings, indicating the volume and intensity of the sound. The overall structure of the score suggests a complex and dynamic musical piece.

HH

64

Event 40

II

323 (Percussion half step up and down)

FL/Pic. *mf* *mp* *mf* *mp* *mf*

Ob. *mf* *mp* *mf* *mp* *mf*

B. Cl. *mf* *mp* *mf* *mp* *mf*

C. Bass/Bar. *mf* *mp* *mf* *mp* *mf*

323 Hrn. *mf* *mp* *mf* *mp* *mf*

C. Tpt. *mf* *mp* *mf* *mp* *mf*

Trbn. *mf* *mp* *mf* *mp* *mf*

Tuba *mf* *mp* *mf* *mp* *mf*

323 Perc. 1 *p* *mf* *p* *mf* *p*

Perc. 2 *mf* *p* *mf* *p* *mf*

Perc. 3 *f* *mf* *f* *mf* *f*

323 Hp. *f* *mf* *f* *mf* *f*

Pnc. *mf* *f* *mf* *f* *mf*

323 Clar. S. *mp* *f* *ff* *ff* *mf* *ff*

323 Vln. I 1 *mf* *f* *mf* *mp* *f*

Vln. I 2 *mf* *f* *mf* *mp* *f*

Vln. II 1 *mf* *f* *mf* *mp* *f*

Vln. II 2 *mf* *f* *mf* *mp* *f*

Vla. 1 *mf* *f* *mf* *mp* *f*

Vla. 2 *mf* *f* *mf* *mp* *f*

Vc. 1 *mf* *f* *mf* *mp* *f*

Ch. 1 *p* *mp* *f*

66

JJ

67

1338
 Fl./Pic. *mf* *mp* *pp*
 Ob. *mf* *mp* *pp*
 B. Cl. *mf* *mp* *pp*
 C. Bas./
 Bar. *mf* *mp* *pp*
 1338
 Hs. *mf* *f* *mp* *p*
 C. Trp. *mf* *f* *mp* *p*
 Tbn. *mf* *f* *mp* *p*
 Tuba *mf* *f* *mp* *p*
 Perc. 1 1338 *mf* *mp* *p*
 Perc. 2 *mf* *mp* *p*
 Perc. 3 *mf* *p*
 Hp. 1338 *f* *mp* *p*
 Cel. 1338 *mf* *p*
 Clar. S. 1338 *f* *ff*
 Vln. I. 1338 *f* *mf* *mp* *p*
 Vln. II. 1338 *f* *mf* *mp* *p*
 Vln. III. 1338 *f* *mf* *mp* *p*
 Vln. IV. 1338 *f* *mf* *mp* *p*
 Vla. 1 *f* *mf* *mp* *p*
 Vla. 2 *f* *mf* *mp* *p*
 Vc. 1 *f* *mf*
 Vc. 2 *f* *mf*
 Cb. 1 *f* *mf*
 Cb. 2 *f* *mf*

KK

Event 42

LL

♩ = 176

Instrument List:

- Fl/Pic.
- Ob.
- B. Cl.
- C. Ban./Ban.
- Hn.
- C. Tpt.
- Tbn.
- Tuba
- Perc. 1
- Perc. 2
- Perc. 3
- Hp.
- Pno.
- Vln. I 1
- Vln. I 2
- Vln. II 1
- Vln. II 2
- Vla. 1
- Vla. 2
- Vcl. 1
- Vcl. 2
- Cb. 1
- Cb. 2
- 2 Congas
- Susp. Cymbal
- Bass Drum

Performance Markings:

- 344** (Measure number)
- mp** (mezzo-piano)
- mf** (mezzo-forte)
- p** (piano)
- Electronics 5 secs.**
- To Bass Drum**

Section Labels:

- small Cymbal (hand)
- Medium Cymbal (hand)
- Wood Chimes

Event 43

351

Fl. Picc. *f*

Ob. *f*

B. Cl. *f*

C. Bsn./ Bsn. *f*

351

Hr. *f*

C. Tpt. *f* *senza sord.*

Tbn. *f* *senza sord.*

Tuba *f* *senza sord.*

351

Perc. 1 *f*

Perc. 2 *f*

Perc. 3 *f* [Large Tam Tam]

351

Hrp. *f*

351

Pno. *f*

351

Vln. I 1 *f*

Vln. I 2 *f*

Vln. I 3 *f*

Vln. II 1 *f*

Vln. II 2 *f*

Vla. 1 *f*

Vla. 2 *f*

Vcl. 1 *f*

Vcl. 2 *f*

Ch. 1 *f*

Ch. 2 *f*

NN

D

Event 46

00

Instrument List:

- Fl/Pic.
- Ob.
- B. Cl.
- C. Bas./Bas.
- Hr.
- C. Tpt.
- Tbn.
- Tuba
- Perc. 1
- Perc. 2
- Perc. 3
- Hp.
- Pian.
- Clar. E.
- Vln. I 1
- Vln. I 2
- Vln. II 1
- Vln. II 2
- Vla. 1
- Vla. 2
- Vcl. 1
- Ch. 1

Measure Markers: 371, 372, 373, 374, 375, 376

Performance Instructions:

- Perc. 1:** *p*, *sf*, *>*
- Perc. 2:** *p*, *sf*, *>*
- Perc. 3:** *p*, *sf*, *>*
- Hp. (Measures 375-376):** *dim.*, *sf*, *dim.*
- Pian. (Measure 376):** *sf*

74

PP

This page of the musical score contains the following staves and markings:

- Fl/Pic:** Flute/Piccolo staff with musical notation.
- Ob:** Oboe staff with musical notation.
- B. Cl:** Bassoon staff with musical notation.
- C.Bsn/Bus:** Bassoon/Baritone staff with musical notation.
- Ha:** Horn staff with musical notation.
- C.Tpt:** Cornet/Trumpet staff with musical notation.
- Tbn:** Trombone staff with musical notation.
- Tuba:** Tuba staff with musical notation.
- Perc. 1:** Percussion 1 staff with musical notation and a **Castanets** marking.
- Perc. 2:** Percussion 2 staff with musical notation and **4 Wood blocks** and **4 Tom toms** markings.
- Perc. 3:** Percussion 3 staff with musical notation and a **mf** marking.
- Hr:** Harp staff with musical notation.
- Pno:** Piano staff with musical notation.
- Clar. S:** Clarinet in S staff with musical notation and a **train imitation with Voice** marking.
- Vln. 11:** Violin 11 staff with musical notation.
- Vln. 12:** Violin 12 staff with musical notation.
- Vla. II 1:** Viola II 1 staff with musical notation.
- Vla. II 2:** Viola II 2 staff with musical notation.
- Vla. 1:** Viola 1 staff with musical notation.
- Vla. 2:** Viola 2 staff with musical notation.
- Vc. 1:** Violoncello 1 staff with musical notation.
- Ch. 1:** Double Bass 1 staff with musical notation.

The score includes various musical notations such as notes, rests, and dynamics (e.g., **mf**). Performance instructions like **Castanets**, **4 Wood blocks**, **4 Tom toms**, and **train imitation with Voice** are also present.

Event 48

▼
QQ

395

FL/Pic.

Ob.

B. Cl.

C. Bsn./
Bsn.

395

Hr.

C. Tpt.

Tbn.

Tuba

395

Perc. 1

Susp. Cymbal

Perc. 2

Medium Tam Tam

4 Tom toms

Perc. 3

395

Hp.

395

Pno.

395

Clar. S.

395

Vln. I 1

8^{va}

mf G.D.

Vln. I 2

mf G.D.

Vln. II 1

mf G.D.

Vln. II 2

mf G.D.

Vla. 1

Vla. 2

Vc. 1

Vc. 2

Ch. 1

mf

78

Electronics 10 seconds until end



DELUGE 洪水

for Ensemble with Live Electronics

FANG Man (2008-9)

Inspired by a Painting of Vasily Kandinsky

Composition VI: "Deluge" (1913)



天下莫柔弱于水，
而攻坚强者，莫之能胜也，
以其无以易之也。
柔之胜刚也，弱之胜强也，
天下莫不知，莫能行。
是以圣人云：
受国之垢，是谓社稷主；
受国不祥，是为天下王。
正言若反。

老子

*Nothing in the world is weaker than water
but against the hard and strong
nothing excels it
for nothing can change it
the soft overcomes the hard
the weak overcomes the strong
this is something everyone knows
but no one is able to practice
thus the sage declares
who accepts a country's disgrace
we call the lord of soil and grain
who accepts a country's misfortune
we call the king of all under Heaven
upright words sound upside down*

*from Lao-tzu's "Tao te ching"
Translated by Bill Porter*

This work was composed between 2008 and 2009, commissioned by the Los Angeles Philharmonic Association, and premiered by the Los Angeles Philharmonic New Music Group under the baton of Esa-Pekka Salonen at Walt Disney Concert Hall, Los Angeles on April 7, 2009

The piece is dedicated to Esa-Pekka Salonen, and my teacher Steven Stucky for his 60th birthday.

The live Electronics is created with the assistant and tools designed with sound engineer Alexis Baskind

Instrumentation:

**1 Flute doubling Piccolo and Alto Flute; 1 Oboe;
1 Clarinet in Bb; 1 Bassoon;*

*1 French Horn; 1 Trumpet in C doubling Trumpet in D; 1 Trombone,
1 Tuba;*

3 Percussion; Harp, Piano dbl Celesta; 1 Midi Keyboard; Strings (2-2-2-2)

**Percussion: (3 players)*

*I: Susp. Cymbal; Musical Saw; 2 Gongs (Large and Medium), also as Water
Gongs; Marimba; Crotales; 1 Timpani; 8 Crystal Glasses; Xylophone (f to c4); 7
Roto-Toms; 2 Wind Chimes; Sizzle Cymbal;*

*II: Susp. Cymbal; 4 Tom-Toms; Vibraphone (f to c4); Flexatone, Crotales, 8 Crystal
Glasses;
2 Wind Chimes; Sizzle Cymbal; 1 Timpani;*

*III: Waterphone; Glockenspiel; 6 Crystal Glasses; Large Tam Tam; Bass Drum;
Chimes;
Sizzle Cymbal*

Performance Notes:

*This score is written at actual sounding pitch except Piccolo,
Celesta, Crystal Glasses; Glockenspiel, Xylophone,
Crotale, and Double Bass.*

The Harp is featured as a solo instrument from rehearsal S to the end

Duration: ca. 14 minutes

Picc./
FL/
AFL. *rit.* *slight slower, ♩ = 66*
pp *mp* *pp*

Ob. *pp* *mp* *pp*

B♭ Cl. *pp* *mp* *pp*

Bsn. *p* *mp* *pp*

Hrn. *con sord.* *pp* *p*

C Tpt./
D Tpt. *con sord.* *pp* *p* *pp*

Tbn. *con sord.* *pp* *p*

Tuba *con sord.* *pp* *p*

Perc. 1 *mp* *mf* *p*
soft mallets Ex.

Perc. 2 *p*
mallet on

Perc. 3 *pp*

Hrp. *mp* *f* *p*

Pno./
Cel. *pizz.* *Inside Piano* *pizz.* *Palm of hands strikes strings* *Celesta* *Ex.* *p*

Elec.

Mid. K. *Event 2*

Vla. 1 *mp* *mf* *f* *mf* *subito p*

Vla. 2 *mp* *mf* *f* *mf* *subito p* *p*

Vla. 1 *mp* *mf* *f* *mf* *subito p*

Vla. 2 *mp* *mf* *f* *mf* *subito p*

Vc. 1 *mp* *mf* *f* *mf* *subito p*

Vc. 2 *mp* *mf* *f* *mf* *subito p*

Ch. 1 *mp* *mf* *f* *mf* *subito p*

Ch. 2 *mp* *mf* *f* *mf* *subito p*

87

88

90

Perc. 1
 Perc. 2
 Perc. 3
 Picc./
 H.F.
 A.F.
 Ob.
 Bb. Cl.
 Bsn.
 Hn.
 C Trp./
 D Trp.
 Tbn.
 Tuba
 Hp.
 Pno/
 Cel.
 Elac.
 Midi K.
 Vln. 1
 Vln. 2
 Vla. 1
 Vla. 2
 Vcl. 1
 Vcl. 2
 Cb. 1
 Cb. 2

Event 9

Musical score page 91, featuring a large ensemble of instruments including woodwinds, brass, strings, and percussion. The score includes various musical notations such as notes, rests, and dynamic markings (p, mp, mf).

92

93

94

96

Picc./
Fl.
A.F.

Ob.

B♭-Cl.

Bsn.

Hn.

C Tpt./
D Tpt.

Tbn.

Tuba

Perc. 1
Marimba

Perc. 2

Perc. 3
Glo.

Hp.

Pno./
Cel.

Elec.

Multi K.
Event 17

Vln. 1
ad. post.
II

Vln. 2
ad. post.
III

Vla. 1
ad. post.
III

Vla. 2
ad. post.
III

Vc. 1

Vc. 2

Cb. 1

Cb. 2

Musical score page 97, featuring orchestral and chamber instruments. The score includes parts for Piccolo/Flute A.F., Oboe, B♭ Clarinet, Bassoon, Horn, C Trumpet/D Trumpet, Trombone, Tuba, Percussion 1 (Marimba), Percussion 2, Percussion 3 (Glockenspiel), Harp, Piano/Cello, Electric, Multi K. (Event 17), Violin 1, Violin 2, Viola 1, Viola 2, Violoncello 1, Violoncello 2, Contrabass 1, and Contrabass 2. The score is written in 4/4 time and includes various dynamics (p, pp, mp, mf, nf) and articulations (acc. and, dolce, and, dolce, arco).

F slight slower, $\text{♩} = 66$ *poco a poco accel.* $\text{♩} = 38$ $\text{♩} = 76$

Picc./Fl./A.F. *pp*

Ob. *pp*

B♭-Cl. *pp*

Bsn. *pp*

Hr. *pp*

C Tpt./D Tpt. *pp*

Tbn. *pp*

Tuba *pp*

Perc. 1 *pp* **Crit.**

Perc. 2 *p*

Perc. 3 *p*

Hrp. *p*

Picc./Cel. *p*

Elec. *p*

Event 18 **Event 19**

Midi K.

Vln. 1 *p* *and point.* *III* *mp* *pp*

Vln. 2 *p* *and point.* *III* *mp* *pp*

Vla. 1 *p* *and point.* *III* *mp* *pp*

Vla. 2 *p* *and point.* *III* *mp* *pp*

Vc. 1 *p* *and point.* *III* *mp* *pp*

Vc. 2 *p* *and point.* *III* *mp* *pp*

Ch. 1 *p* *and point.* *III* *mp* *pp*

Ch. 2 *p* *and point.* *III* *mp* *pp*

G

Picc./Fl./A.F.I. *mf* *p* *mp*

Ob. *mf* *p* *mp*

B♭ Cl. *mf* *p* *mp*

Bsn. *mf* *p* *mp*

Hrn. *mf* *p* *mp*

C Trp./D Trp. *mf* *p* *mp*

Tbn. *mf* *p* *mp*

Tuba *mf* *p* *mp*

Perc. 1

Perc. 2

Perc. 3

Hrp. *mf* *p* *mp*

Pan/Cel. *mf* *p* *mp*

Elec.

Midi K.

Event 21 **Event 22**

Vla. 1 *dolce, ond.*

Vla. 2 *dolce, ond.*

Vla. 1 *dolce, ond.*

Vla. 2 *dolce, ond.*

Vc. 1 *dolce, ond.*

Vc. 2 *dolce, ond.*

Ch. 1 *arco sul pont. III* *f*

Ch. 2 *arco sul pont. IV* *f*

Event 23

30

Picc./
Fl.
A.F.I.

f

Ob.

f

B♭-Cl.

f

Bsn.

f

Hrn.

mf

C Tpt./
D Tpt.

mf

Tbn.

mf

Tuba

mf

Perc. 1

Perc. 2

Perc. 3

Hp.

Picc./
Ccl.

f

Elec.

Event 24

Mid. K.

Vla. 1

Vla. 2

Vla. 1

Vla. 2

Vc. 1

Vc. 2

Ch. 1

Ch. 2

pizz.

arco

pizz.

arco

$\boxed{H} \bullet = 66$

104

105

I $\text{♩} = 72$
non espressivo

Picc./Fl./A/E *mp*
non espressivo

Ob. *mp*
non espressivo

B♭ Cl. *mp*
non espressivo

Bsn. *mp*
non espressivo

Hr. *mf* *sf*
non espressivo

C Tpt./D Tpt. *mf* *sf*
non espressivo

Tbn. *fp* *mf* *fp*
non espressivo

Tuba *fp* *mf* *fp*
non espressivo

Perc. 1 *mf* *sf* *fp*
non espressivo

Perc. 2 *mf* *sf* *fp*
non espressivo

Perc. 3 *mf* *sf* *fp*
non espressivo

Hp. *fp* *mf* *fp*
non espressivo

Picc./Cél. *fp* *mf* *fp*
non espressivo

Elec. *fp* *mf* *fp*
non espressivo

Midi K. *fp* *mf* *fp*
non espressivo

Vln. 1 *mf* *sf* *fp*
non espressivo

Vln. 2 *mf* *sf* *fp*
non espressivo

Vla. 1 *mf* *sf* *fp*
non espressivo

Vla. 2 *mf* *sf* *fp*
non espressivo

Vc. 1 *mf* *sf* *fp*
non espressivo

Vc. 2 *mf* *sf* *fp*
non espressivo

Ch. 1 *mf* *sf* *fp*
non espressivo

Ch. 2 *mf* *sf* *fp*
non espressivo

Smp. Cymbal *mf* *sf* *fp*
non espressivo

Bass Drum *mf* *sf* *fp*
non espressivo

Event 28

107

108

112

113

Picc./Fl. A.F.
 Ob.
 Bb-Cl.
 Bsn.
 Hrn.
 C Trp./D Trp.
 Tbn.
 Tuba
 Perc. 1
 Perc. 2
 Perc. 3
 Hrp.
 Piano
 Elec.
 Midi K.
 Vln. 1
 Vln. 2
 Vla. 1
 Vla. 2
 Vc. 1
 Vc. 2
 Ch. 1
 Ch. 2

Event 47
 Event 48
 Event 49
 Event 50
 Event 51

4 Tom-Toms
 Tam-Tam with suspended

mp
 p
 pp

115

Picc./
Fl.
A.R.

Ob.

Bb. Cl.

Bsn.

Hrn.

C Trp./
D Trp.

Tbn.

Tuba

Perc. 1

Perc. 2

Perc. 3

Hrp.

Pno./
Cel.

Elec.

Multi K.

Vln. 1

Vln. 2

Vla. 1

Vla. 2

Vc. 1

Vc. 2

Ch. 1

Ch. 2

Event 56

Event 57

Event 58

Event 59

Event 60

Picc./ Fl. A.H. *mf* *mp* *mf* *mp*
 Ob. *mf* *mp* *mf* *mp*
 Bb Cl. *mf* *mp* *mf* *mp*
 Bsn. *mf* *mp* *mf* *mp*
 Hrn. *p* *mf* *mp* *mf* *mp*
 C Tpt./ D Tpt. *p* *mf* *mp* *mf* *mp*
 Tbn. *p* *mf* *mp* *mf* *mp*
 Tuba *p* *mf* *mp* *mf* *mp*
 Perc. 1 [7 Roto Toms] *p* *mf* [Crot.]
 Perc. 2
 Perc. 3
 Hp. *mp*
 Perc./ Cdl. *mp*
 Elec.
 Midi K. [Event 61] [Event 62] [Event 63] [Event 64] [Event 65]
 Vln. 1 *mp*
 Vln. 2 *mp*
 Vla. 1 *mf* *mp*
 Vla. 2 *mf* *mp*
 Vc. 1 *mf* *mp*
 Vc. 2 *mf* *mp*
 Ch. 1 *mf* *mp*
 Ch. 2 *mf* *mp*

118

P

repeat the pattern as fast as possible

mf

f

Ob.

repeat the pattern as fast as possible

mf

f

B♭-Cl.

repeat the pattern as fast as possible

mf

f

Bsn.

repeat the pattern as fast as possible

mf

f

Hr.

mp

mf

f

C. Tpt./
D. Tpt.

mp

mf

f

Tbn.

mp

mf

f

Tuba

mp

mf

f

Perc. 1

Perc. 2

Perc. 3

Hrp.

Picc./
Ccl.

f

Elec.

Event 70

Event 71

Event 72

Midi K.

Vln. 1

f

as if playing harmonics

ff

Vln. 2

f

as if playing harmonics

ff

Vla. 1

f

as if playing harmonics

ff

highest possible note

Vla. 2

f

as if playing harmonics

ff

highest possible note

Vc. 1

f

as if playing harmonics

ff

highest possible note

Vc. 2

f

as if playing harmonics

ff

highest possible note

Ch. 1

f

as if playing harmonics

ff

highest possible note

Ch. 2

f

as if playing harmonics

ff

highest possible note

124

Picc./
Fl.
A.R.

mp

mf

mp

Ob.

mp

mf

mp

B♭ Cl.

mp

mf

mp

Bsn.

mp

mf

mp

Hr.

mp

f

p

C Trp./
D Trp.

mp

f

p

Tbn.

mp

f

p

Tuba

mp

f

p

Perc. 1

mp

mf

p

Perc. 2

mp

mf

p

Perc. 3

mp

mf

p

Hrp.

mp

p

Pan./
Cdl.

mp

mp

Elec.

Event 73

Event 74

Event 75

Midi K.

Vln. 1

mp

Vln. 2

mp

Vla. 1

mp

Vla. 2

mp

Vc. 1

p

mp

Vc. 2

p

mp

Ch. 1

p

Ch. 2

p

Q

Picc./
Fl./
A.F.

mf *mp* *p* *play as fast and smooth as possible*

Ob.

mf *mp* *p* *play as fast and smooth as possible*

Bb Cl.

mf *mp* *p* *play as fast and smooth as possible*

Bsn.

mf *mp* *p* *play as fast and smooth as possible*

Hrn.

mf *mp* *p*

C Tpt./
D Tpt.

mf *mp* *p*

Tbn.

mf *mp* *p*

Tuba

mf *mp* *p*

Perc. 1

mf *mp* *p*

Perc. 2

mf *mp* *p*

Perc. 3

mf *mp* *p*

Hp.

mf

Pno./
Cel.

mf *mp* *mf*

Elec.

Mtd K.

Event 76

Vln. 1

mf *pizz.* *arco*

Vln. 2

mf *pizz.* *arco*

Vln. 1

mf *pizz.* *arco*

Vln. 2

mf *pizz.* *arco*

Vc. 1

mf *pizz.* *arco*

Vc. 2

mf *pizz.* *arco*

Ch. 1

mf *pizz.*

Ch. 2

mf *pizz.*

122

ff To Alto Flute

Picc./
Fl./
A.Fl.

Ob.

B♭-Cl.

Bsn.

Hrn.

C Trp./
D Trp.

Tbn.

Truba

Perc. 1

Perc. 2

Perc. 3

Hp.

Pan./
Cel.

Elec.

Midi K.

Vla. 1

Vla. 2

Vla. 1

Vla. 2

Vc. 1

Vc. 2

Ch. 1

Ch. 2

S ♩ = 46

8 Crystal Glasses (c#2-d#2-e2-f#2-g#2-a2-b2)

8 Crystal Glasses (c2-c#2-d2-e2-f#2-g2-a2-b2)

6 Crystal Glasses

Harp Solo (transcribed from "Flowing Water", a Guqin piece from the ancient China)

right hand holding a metal tuning key
(near the soundboard with nail)

Program Change III

Event 79

Event 80

Event 81

125

127

128

129

Picc./Fl. A.F. *pp* *p* *pp* *p*
 Ob. *pp* *p* *pp* *p*
 B♭-Cl. *pp* *p* *pp* *p*
 Bsn. *pp* *p* *pp* *p*
 Hrn. *pp* *mp* *pp* *pp* *pp* *pp*
 C.Tpt./D.Tpt. *pp* *mp* *p* *pp* *p* *pp* *pp*
 Tbn. *pp* *mp* *p* *pp* *p* *pp* *pp*
 Tuba *pp* *mp* *p* *pp* *p* *pp* *pp*
 Perc. 1 *mf* glass, with pedal
 Perc. 2 *mf*
 Perc. 3 *mf*
 Hp. *mp*
 Pno./Cello *p* *mp* *mp*
 Elec.
 Midi K. Event 98 Event 99 Event 100 Event 101 Event 102 Event 103 Event 104
 Vla. 1 *mp* *p* *mp* *f* *mp* *p* *pizz.*
 Vla. 2 *mp* *p* *mp* *f* *mp* *p* *pizz.*
 Vla. 1 *mp* *p* *mp* *f* *mp* *p* *pizz.*
 Vla. 2 *mp* *p* *mp* *f* *mp* *p* *pizz.*
 Vc. 1 *mp* *p* *mp* *f* *mp* *p* *pizz.* *arco* *pizz.*
 Vc. 2 *mp* *p* *mp* *f* *mp* *p* *pizz.* *arco* *pizz.*
 Ch. 1 *mp* *p* *mp* *f* *mp* *p* *pizz.* *arco* *pizz.*
 Ch. 2 *mp* *p* *mp* *f* *mp* *p* *pizz.* *arco* *pizz.*

W Piu Mosso poco a poco accel.

Picc./Fl./A.H. *mp* *p* *pp* *p*

Ob. *mp* *p* *pp* *p*

Bs. Cl. *mp* *p* *pp* *p*

Bsn. *mp* *p* *pp* *p*

Hrn. *mp* *p* *pp* *p*

C. Tpt./D. Tpt. *mp* *p* *pp* *p*

Tbn. *mp* *p* *pp* *p*

Tuba *mp* *p* *pp* *p*

Perc. 1 *mp* *mf* *mp* *p* *mp*

Perc. 2 *mp* *gliss. with pedal* *mp* *p* *mp*

Perc. 3 *mp* *mp* *p* *mp*

Hp. *mf* *mp* *mf* *mp*

Pan./Col. *mp* *p* *pp* *p*

Elec. *mp* *p* *pp* *p*

Mid. K. *mp* *p* *pp* *p*

Vln. 1 *mp* *f* *mp* *p* *pp* *p*

Vln. 2 *mp* *f* *mp* *p* *pp* *p*

Vla. 1 *mp* *f* *mp* *p* *pp* *p*

Vla. 2 *mp* *f* *mp* *p* *pp* *p*

Vc. 1 *mp* *f* *mp* *p* *pp* *p*

Vc. 2 *mp* *f* *mp* *p* *pp* *p*

Ch. 1 *mp* *f* *mp* *p* *pp* *p*

Ch. 2 *mp* *f* *mp* *p* *pp* *p*

Ev105 Ev106 Ev107 Ev108 Ev109 Ev110 Ev111 Ev112

132

133

Picc./
Fl.
A.F.

Ob.

B♭ Cl.

Bsn.

Hn.

C Tpt./
D Tpt.

Tbn.

Tuba

Perc. 1

Perc. 2

Perc. 3

Hrp.
*Left hand play with a metal stick
(round head to use to avoid stick between the strings)*

Picc./
Cel.

Elec.

Midi K.

Ev120 Ev121 Ev122 Ev123 Ev124

Vla. 1

Vla. 2

Vla. 1

Vla. 2

Vc. 1

Vc. 2

Cb. 1

Cb. 2

134 Y $\text{♩} = 120$

Picc./
Fl./
A.Fl.

Ob.

B♭-Cl.

Bon.

Hr.

C.Tpt./
D.Tpt.

Tbn.

Tuba

Perc. 1

Perc. 2

Perc. 3

Hp.

Celesta

Pan/
Ccl.

Elec.

Midi K.

Ev125

Ev126

Vln. 1

Vln. 2

Vla. 1

Vla. 2

Vc. 1

Vc. 2

Ch. 1

Ch. 2

136

Z2 *poco a poco rit.* $\text{♩} = 72$

Picc./FL/A.FL. *fp*

Ob. *fp*

B♭ Cl. *fp*

Bsn. *fp*

Hr. *fp* *mf* *p*

C Tpt./D Tpt. *fp* *mf* *p*

Tbn. *fp* *mf* *p*

Tuba *fp* *mf* *p*

Perc. 1 *mf*

Perc. 2 *mf*

Perc. 3 *mf*

Hp. *mf* *put down the sticks* *poco a poco rit.* *put down the sticks* *mp* *mp*

Pno./Cdl. *mf*

Elec.

Midi K. **Ev137** **Ev138**

Vln. 1 *mf* *poco a poco dim. & rit.* *p*

Vln. 2 *mf* *poco a poco dim. & rit.* *p*

Vln. 1 *mf* *poco a poco dim. & rit.* *p*

Vln. 2 *mf* *poco a poco dim. & rit.* *p*

Vc. 1 *mf* *poco accel. to rit.* *mf* *poco a poco dim. & rit.*

Vc. 2 *mf* *poco accel. to rit.* *mf* *poco a poco dim. & rit.*

Ch. 1 *mf* *poco a poco dim. & rit.*

Ch. 2 *mf* *poco a poco dim. & rit.*

Picc. Fl. A.Fl.		$\frac{3}{4}$
Ob.		$\frac{3}{4}$
B♭ Cl.		$\frac{3}{4}$
Bsn.		$\frac{3}{4}$
Hr.		$\frac{3}{4}$
C.Tpt./ D.Tpt.		$\frac{3}{4}$
Trbn.		$\frac{3}{4}$
Trbn.		$\frac{3}{4}$
Perc. 1		$\frac{3}{4}$
Perc. 2		$\frac{3}{4}$
Perc. 3		$\frac{3}{4}$
Hp.		$\frac{3}{4}$
Pan./ Ccl.		$\frac{3}{4}$
Elec.		$\frac{3}{4}$
Midi K.		$\frac{3}{4}$
Vln. 1		$\frac{3}{4}$
Vln. 2		$\frac{3}{4}$
Vla. 1		$\frac{3}{4}$
Vla. 2		$\frac{3}{4}$
Vc. 1		$\frac{3}{4}$
Vc. 2		$\frac{3}{4}$
Ch. 1		$\frac{3}{4}$
Ch. 2		$\frac{3}{4}$

Electronics 12 seconds

Coda (Free and not to be conducted except to give the begin and end sign)

208 Gong (Medium) play in the water

Perc. 1 *ppp*

208 8 Crystal Glasses *pp*

Perc. 2 *ppp*

Waterphone *sim.*

Perc. 3 *ppp*

208 Hp. *p*

pp play with the back of the nails

poco a poco accel.

208 Pno./ Cel. (gliss with chisel on C string)

pizz.

ff

Elec.

208 Ev139

Midi K.

*** The technique is adopted from George Crumb's *Ancestral Voice of Children*, in which he indicates the procedure as below: "use 5/8" Chisel with smooth cutting edge, apply chisel (held in R.H.) to C string at proper point to produce the written F. Phrase begin with left hand plucking C string after chisel is in position. After Pizz. note, the chisel is moved along the string to produce the various written pitches. The movement of Chisel should be rapid at decisive between pitches in order to produce a distinct sound. The amplification of piano will help to project these delicate sound."



213 Perc. 1 *ppp*

213 Perc. 2 *ppp*

213 Perc. 3 *ppp* *mp* *ppp* *mp* *ppp* *p*

213 Hp. *mp*

213 Pno./ Cel.

Elec.

213 Ev140

Midi K.

UTILIZING OPENMUSIC AS A TOOL FOR THE ANALYSIS
OF LUTOSŁAWSKI'S CHAIN 2

Part II

A Dissertation

Presented to the Faculty of the Graduate School
of Cornell University

In Partial Fulfillment of the Requirements for the Degree of
Doctor of Musical Arts

by

Man Fang

May 2010

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UTILIZING OPENMUSIC AS A TOOL FOR THE ANALYSIS OF LUTOSŁAWSKI'S CHAIN 2

Man Fang, D.M.A.

Cornell University 2010

Lutosławski is highly regarded as one of the most important composers of the twentieth century. He is influential not only through his music but also through his way of thinking about music and compositional techniques. Due to the complex nature of his music and techniques, few people have acquired adequate knowledge about him. Therefore, I have been searching for a method that would allow easier access to such treasures and I consider the adaptation of computer music program—OpenMusic (OM)—as one of the methods that may achieve this goal. Music analysis using the computer is not a new subject, as it can be traced at least back to the 1950s. However, using OM to analyze music is fresh territory that has only begun to attract researchers and theorists. Following its rapid development, it stands out from various similar programs thanks to its unique graphic interface and open environment for its users. In this paper, I have designed and adapted computer tools in the OM environment for the musical analysis of Lutosławski's *Chain 2*—a violin concerto that was greatly favored by the composer himself. This methodology not only increases the speed of the analysis but also improves the clarity and accuracy. A substantial advantage of this method is the availability to overview the pitch and time structures in the OM-*maquette* environment, which greatly eases the discovery and comparison of inner relationships of the materials.

BIOGRAPHICAL SKETCH

Hailed as “inventive and breathtaking” by *New York Times* critic Steven Smith, Man Fang’s original concert music has been performed worldwide by notable orchestras and ensembles such as the Los Angeles Philharmonic Orchestra New Music Group under the baton of Esa-Pekka Salonen, Tokyo Philharmonic Orchestra, Orchestre National de Lorraine (France), Minnesota Orchestra, American Composers Orchestra, Peabody Symphony Orchestra, Music from China, among others. She is the recipient of a Los Angeles Philharmonic Association commission, an Underwood/ACO New Music commission, Toru Takemitsu Award, Dolce Suono Ensemble Mahler Schoenberg Project commission, Asian Young Composers commission (Taiwan), Bank of America commission, the Darmstadt Stipend-Prize-Award, SACEM Scholarship (France), Kate Neal Kinley Memorial Fellowship, Frank Huntington Beebe Fellowship, Centre Acanthes Bursary Award, Music from China Award, Olin and Sage Fellowships (Cornell), Cecil Effinger Fellowships (University of Colorado Boulder), AMC Composers Assistant Grant, ASCAPlus Award, among others. Her music has been performed at Carnegie Hall (New York), Walt Disney Hall (Los Angeles), Espace de Projection of IRCAM-Centre Pompidou (Paris), Tokyo Opera City Concert Hall, Annenberg Center for the Performing Arts (Philadelphia), Friedberg Concert Hall (Baltimore), Miller Theater of Columbia University (New York), Bank of America Tower (Seattle), Merkin Concert Hall (New York), Beijing Concert Hall, etc. She has been invited to new music festivals such as the Festival Présences of Radio France, Darmstadt International Summer Course for New Music (Germany), Centre Acanthes (Avignon and Metz, France), Festival Blurred Edges (Hamburg, Germany), Global Ear Festival (Dresden, Germany), Sinus~Ton Festival (Magdeburg, Germany), the Cabrillo Festival (Santa Cruz, USA), Aspen Music

Festival (Aspen, USA), Gaudeamus Music Week (Amsterdam, the Netherlands), June in Buffalo (Buffalo, USA), and Bowdoin Summer Music Festival (USA) among others. She has been invited as a resident composer at the Hermitage Artist Retreat in Florida as well as at the Aldeburgh Music Centre in the UK.

Man Fang is a Chinese-born composer who lives in the United States. Her primary teachers include Steven Stucky and Roberto Sierra at Cornell University, where she obtained the MFA in 2006 and the DMA in 2010. She was chosen to participate in the one-year Computer Music and Composition courses at IRCAM-Centre Pompidou between 2006 and 2007, where she studied composition with Brian Ferneyhough, Mikhail Malt, Yan Marez, and Tristan Murail. She has also studied with Richard Toensing and Michael Theodore at the University of Colorado at Boulder between 2000 and 2002. Before she moved to the United States in 2000, she obtained the BM degree from the Central Conservatory of Music in Beijing, where she studied with Du Mingxin and Ye Xiaogang.

For Yi Sun

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PREFACE

I first encountered Lutosławski's music when I was still a college student studying at the Central Conservatory of Music in Beijing, China. During the 1990s, the original recordings of Western contemporary music were just slowly brought to the country, which attracted many enthusiastic music lovers. I was one of them. At that time, one important activity for the weekend for me was to visit the few music stores in the city. Later I met my husband, who is also a fan of classical music, and we sometimes took buses for hours in order to find the newly opened music stores. It was during this time that we discovered the CD of Lutosławski's music, Sony's 1994 release of Lutosławski's Third and Fourth symphonies along with John Shirley-Quirk singing his *Les Espaces du Sommeil* and Esa-Pekka Salonen conducting the Los Angeles Philharmonic. That was probably the only CD I could find with Lutosławski's music at the time, and I listened countless times. Along with another of my favorite recordings, Toru Takemitsu's *Quotation of Dream*, it was a treasure. Since then, I have been a loyal admirer of his music and I consider his Third Symphony one of my favorite pieces of the twentieth century. After I moved to the United States in 2000, I had the opportunity to listen to much more of his music and gradually obtained a large personal collection of his recordings. However, not until I took the Lutosławski seminar offered by my teacher Steven Stucky at Cornell, did I begin to understand in greater depth his compositional techniques, especially his treatment of harmony, orchestration, and form, which has profoundly influenced my musical thinking and helped me build my own compositional systems. Until now, it still amazes me that I continue to discover new ideas through the study of his music, and I never feel bored listening to his music, even after more than a decade.

During almost sixty years of Lutosławski's artistic life, he was continuously searching for new ways to refine his musical language. He composed more than eighty works, which include a large number of symphonic works. Among the many masterpieces he composed, *Chain 2* is considered the one that satisfied composer himself "in every respect."¹ Out of curiosity, I decided to choose this piece for the topic of my dissertation, and I intend to find out what makes the composer happy in terms of his musical philosophy and compositional techniques.

The arithmetic and systematic nature of his compositional approach enables me to make connection with machines, which I believe will serve the purpose of analyzing his music well. I was first introduced to the computer music program OpenMusic (OM) by my teacher, Mikhail Malt, at IRCAM in 2006, when I was attending the one-year composition and computer music courses at IRCAM in Paris. I was immediately attracted to this program and began making connections with Lutosławski's compositional techniques, particularly his limited aleatoric technique; some objects in the OM environment seem perfect for creating such materials. As I later gradually incorporated OM into my own compositions, I became aware of a number of objects that are useful for music analysis, and I developed the idea to adopt OM for the analysis of Lutosławski's music. However, the process was slow and difficult because the many objects of the program were originally created for music composition, not for analysis, which requires further programming to design analytical tools. Due to my limited knowledge and experience of computer programming, I spent a lot of time learning the tools in OM and searching for the programming possibilities tailored to

¹ Nikolska, Irina. *Conversations with Witold Lutoslawski (1987-92)*, tr. Valeri Yerokhin (Stockholm, 1994), 114.

the needs of analyzing Lutosławski's music. Fortunately I was able to develop a library of analytical tools of my own and to complete the analysis of *Chain 2* with their assistance.

Finally, I hope that my work will attract more researchers to develop more computer tools for music analysis in OM or other programs, which aim to provide good resources for music lovers and to help them understand the music they love and admire. Music magically connects us as humans and stimulates our expressions and feelings. Machines help us to find the logic and see it visually.

CHAPTER I

COMPUTATIONAL MUSIC ANALYSIS AND OPENMUSIC

History of Music Analysis with Computers

Music analysis has existed for hundreds of years, can be traced as early as from the Middle Ages, and may be defined as “a search for features”² towards a piece of music. Such features may include melody, harmony, rhythm, structure, timbre, texture, orchestration, as well as dynamics, expression, and so on. Since the twentieth century, the impact of computer science has not only led to a highly multidisciplinary field but also applications to our everyday life. Contemporary musicologists have sought ways to apply the computers to their own research. Mirjana speculates”³:

This pondering about the status of musicology under the conditions of the computer medium has a double impulse. On the one side, it is stimulated by the fact that computer technology, otherwise in a state of permanent development, penetrates all spheres of science, making a strong impact on the aspects of realizing the crucial segments of scientific procedure, thereby, quite naturally, on shaping its final product. On the other side it ensures from the analytical model for re-reading and re-classifying musicological works, that I established in the basis of the genre analogies between the compositional and musicological achievements produced the second half of the 20th century... The computer's multimedial character relies on the medium's ability to realize the individual and simultaneous embodiments of the visual and auditive components.

For dozens of years, musicologists have deliberated about their passion for computational music analysis and have predicted a bright future. Jan LaRue made the following statement in 1966 at the conference “Musicology 1966-2000: A Practical Program”:

² Andrew Brown. “An Introduction to Music Analysis with Computer” in *Music Education and Computers: Amplifying Musicality* (New York: Routledge, 1999), 1.

³ Veselinovic-Hofman, Mirjana. “Musicology Facing the Challenges of Computer Projection of its Interdisciplinarity” in *Computer-Applicants in Music Research: Concepts Methods*, ed. Schöler, Nico (Frankfurt am Main: Peter Lang, 2002), 11.

I should like to suggest that computer analysis will become one of the most important directions in musicology for next generations. One hears frequently the comment that computers will make musicology mechanistic. Bear in mind, however, that the computer does what it is told: even its most sophisticated procedures depend on the imagination of the researcher for instructions; and the final results always require further interpretation. In these two functions – instruction and interpretation – the researcher controls the fundamental musicality of the investigation. If the results are mechanistic, he cannot blame the computer⁴.

However, the current situation of such research appears to have slowed, which will likely thwart the goal of “becoming one of the most important directions in musicology for next generations”. Therefore, questions arise: does this reality imply a dead-end future for computational music analysis? If the answer is no, what were the causes of the impasse, and how can we overcome them? I try to find the answers to these questions with my research. But first, I would like to introduce the history and methods on the subject of computational analysis in order to lay a foundation for my response to these questions.

Before we begin to describe the history of musical analysis with computers, it is essential to mention two pioneers who laid the foundation of the analytical machine: Charles Babbage (1772-1871) and Ada Lovelace (1815-1852). Charles Babbage was an English mathematician and mechanical engineer who invented two types of evolutionary machines, which features were later obtained in the up-to-date models. The first of the two Difference Engines was built in the 1820s and is considered a “father of the computer”. The second machine he built was the Analytical Engine, which is more complex and could be programmed. His follower Ada Lovelace was an English mathematician and widely considered the first person to create a program for machines and hence the world’s first programmer. In one of her notes, she mentioned

⁴ LaRue, Jan, “New Directions for Style Analysis,” *Musicology and the Computer: Three Symposia*, ed. by Barry S. Brook, (New York: The City University of New York Press, 1970), 197.

music and computers:

Again, (the Analytical Engine) might act upon other things besides numbers, were objects found whose mutual fundamental relations could be expressed by those of the abstract science of operations, and which should be also susceptible of adaptations to the action of the operating notation and mechanism of the engine...Supposing, for instance, that the fundamental relations of pitched sounds in the science of harmony and of musical composition were susceptible of such expression and adaptations, the engine might compose elaborate and scientific pieces of music of any degree of complexity or extent⁵.

According to David Cope, Frederick Brooks is probably one of the first people to use the computer for musical analysis. An applied mathematician who was educated at Duke and Harvard Universities and who later taught at the University of North Carolina at Chapel Hill, he analyzed thirty-seven hymn tunes with Markov chains while at Harvard University as early as in 1957. Later, he modeled new hymn tunes on the analysis, which appeared to be quite successful. A paper, "Style as Information," published in the *Journal of Music Theory* in 1958 by Joseph Youngblood, is an influential work of this kind. Again he used Markov chains for the purpose of observing and comparing the musical styles of Schubert, Schumann, and Mendelssohn. Some subsequent programs adopted some principles of his methods, performing similar programmatic operations.

Markov chains are one of the most important methodologies in computational music analysis. Named after Andrei Markov, the term refers to:

a discrete random process with the Markov property. A discrete random process means a system which can be in various states, and which changes randomly in discrete steps. It can be helpful to think of the system as evolving through discrete steps in time, although strictly speaking the "step" may have nothing to do with time. The Markov property states that the probability

⁵ Taylor, Richard, ed., *Scientific Memoirs, Selections from The Transactions of Foreign Academies and Learned Societies and from Foreign Journals*. Vol III (London: From the Bibliothque Universelle de Gneve, 1842), 694.

distribution for the system at the next step (and in fact at all future steps) only depends on the current state of the system, and not additionally on the state of the system at previous steps. Since the system changes randomly, it is generally impossible to predict the exact state of the system in the future. However, the statistical properties of the system at a great many steps in the future can often be described. In many applications it is these statistical properties that are important⁶.

In their book, *Experimental Music*, published in 1959, Lejaren Hiller and Leonard Isaacson discussed the computational music analysis through information theory and statistics. Cope aptly categorized the potential goals for the analytical methods emphasized in the book:

(1) The use of the Monte Carlo method (a process using laws of chance controlled by statistical norms) to experiment with and compare musical forms; (2) the analysis of musical styles based on entropy; (3) the generating and cataloguing of tone rows as cantus firmi for counterpoint (Principle 1); and (4) the analysis of musical timbres (see especially Hiller and Isaacson 1959, 165-170)⁷.

Notable contributions to computational musical analysis in the 1960s include Eric Regener's System for Analysis of Music (SAM), which depended on an IBM 7090 computer to define data types, as well as Stefan Kostka's program that was based on the principles of Hindemith's book *The Craft of Musical Composition* (1942), since his research focused mainly on Hindemith's music. In the 1970s, the subject of musical analysis with computers was significantly developed. Dorothy Gross, a graduate of Indiana University in the 1970s, used her computer programs in music analysis that can group, analyze and count intervals. Fred Hofstetter, currently a professor at the University of Delaware, performed impressive works in the 1970s that

⁶ Wikipedia, "Markov Chain," http://en.wikipedia.org/wiki/Markov_chain.

⁷ Cope, David. *Hidden Structure: Music Analysis Using Computers*. (Madison, WI: A-R Editions, 2009), 28.

described the procedures of identifying stylistic influences. Otto Laske's contribution was primary to the area of music cognition. However, his KEITH is a rule-based system that defines three stages of analytical perception from what is said, to what is heard, to what is understood (analysis).

One of the first computer programs that can generate and analyze prime forms and transformations of all pitch-class sets and their subsets was created by Bo Alphonse⁸ in 1980. Dean Simonton has also done important research in the same year, which uses computers to do analysis on the transitions between the first six notes of 5,046 famous themes of the classical repertoire. He intended to find out what makes them well-known through such study. Another study was done in 1982 by Ann Blombach, a music professor at Ohio State University, which focused on using computers to analyze fifty major-key Bach chorales. The initial goal was to find out what is more important, harmony or counterpoint, in these chorales. Also in 1980, Stephen Smoliar described the procedures of transferring Schenkerian analysis to a computer music program, which includes identifying the three structural layers: foreground, middle ground, and background. He is probably the first person to make such a connection.

In 1984, Charles Ruggiero and James Colman jointly developed the Computer-Assisted Set Analysis Program (CASAP), which is based on Allen Forte's approach to set theory. It is considered one of the first programs of its kind. Besides identifying prime forms, it also searches for similarities and relations of sets with parameters decided by the user. The initial functions of the program were further developed and included in the Contemporary Music Analysis Package (CMAP) by Craig Harris and Alexander Brinkman in 1989, which introduced new elements such as interval-class vectors, subsets, complements, adjacent interval vectors, etc. Nico Schöler and Dirk

⁸ Bo Alphonse was a music professor at McGill University.

Uhrlandt developed the MUSANA program in 1994, which targets musical styles through the analysis of pitch, duration, and meter statistically for mean, standard deviation, frequency correlation, autocorrelation, entropy, etc. John Schaffer developed a program in 1994 that offers interactive flexibility to users while doing analysis. This program also functions as an aid for the analysis of post-tonal music.

Mira Balaban's research focuses on the computational analysis of musical structure. Several programs she designed are based on variable grouping sizes. Another computer program that aims to analyze music expressions was developed by Peter Desain and Henkjan Honing in 1990, which was included in the POCO software package. Kemal Ebcioglu developed a new system called CHORAL, which can harmonize Bach chorales. Another remarkable program, MUSACT developed by Jamshed Bharucha in 1993, used neural nets for harmony analysis.

David Huron⁹ developed Humdrum Toolkit in 1995, which "searches for particular motives, compares voice-leading in various repertoires, counts suspensions, defines and catalogues harmonic progressions, analyzes dissonance in relation to metric position, and performs other such operations¹⁰." It is available at both the sites of Ohio State University and CCRMA of Stanford University. In 2001, David Temperley and Daniel Sleator¹¹ developed the Melisma Music Analyzer, which analyzes meter, voicing, harmony, phrases, key, stream structure and chord function from tonal music using MIDI files as input. Guerino Mazzola and Oliver Zahorka¹² developed RUBATO, which can analyze, compose, and perform music. Its graphic presentation is convincing and helpful for its users. Anthony Pople¹³ created the

⁹ David Huron is a professor of Music Cognition at Ohio State University.

¹⁰ Cope, *Hidden Structure*, 35.

¹¹ David Temperley is currently a professor of Music Theory at Eastman School of Music; Daniel Sleator is a Professor of Computer Science at Carnegie Mellon University.

¹² Guerino Mazzola and Oliver Zahorka are currently researchers of MultiMedia Laboratory at Zurich University.

¹³ Anthony Pople was a Professor at the University of Nottingham in UK. He passed away in 2003.

tonalities program, which is specifically designed to analyze tonal music of the late nineteenth and early twentieth centuries. It is associated with Microsoft Excel and thus has limitations because a specialized format would be required. Probably the most advanced computer program for tonal analysis is the Music Theory Workbench, which was developed by Heinrich Taude at the University of Illinois. It can analyze the functions of chords and their inversions using harmonic rhythm to separate the chords; nonharmonic tones are identified as passing, neighboring, etc. It can also identify tonal center.

Current computer music programs such as OpenMusic (IRCAM-Paris), Elody (GRAME-Lyon), Symbolic Composer (Venice, Italy), Common Music (Stanford Univ.), ALICE (David Cope, UC-Santa Cruz) and so on, aim primarily at computer-assisted composition but provide excellent tools for computational music analysis. However, some of these programs are not available for all systems (e.g., Elody is only available for Windows), or their interfaces are quite unfriendly for non-programmer users (Common Music and ALICE may be included in this category). Symbolic Composer and OpenMusic offer user-friendly environments and are available for all systems (Windows, Mac, and Linux), but they are quite pricy compared to other computer programs. Such circumstances have limited the development of these programs and have particularly decreased the number of users, which in turn caused the unpopularity of these programs.

Methods and Problems of Computational Music Analysis

As we glance at the history of computational music analysis, we can now categorize its existing methods and further discuss the problems that have caused the unpopularity of such approaches. There are at least two primary trends in the field of computational music analysis: notation-based analysis and performance-based

analysis. It is clear that the former is focused on the analysis of a composer's notated score, and the latter is for the analysis of the interpreter's performance of the music.

In "On Classifying Computer-Assisted Music Analysis," Nico Schöler has aptly classified the several methods of approaching music analysis with computers, which include Statistical and Information-Theoretical Methods, Set Theoretical Methods, Other Mathematical Methods, Hierarchical Methods (Transformational Analysis and Schenkerian Analysis), Spectral Analysis, Cognitive & AI Analysis, and Combined Method. These analytical methods may be adopted for one or both trends of the field of computational music analysis.

Statistical and information-theoretical methods are the first among various other types of methods to be applied to computational music analysis. Researchers intend to obtain precise data about the "frequency, mean, variance, standard deviation, correlation, regression, the chi square test, entropy, Markov chains, probability, redundancy and other measurements¹⁴" of their interested works. It proves to be useful for the comparison of the values and sizes of musical units such as melody, rhythm, musical structure, etc. More specifically, this method can improve the accuracy and speed of an analysis based on Allen Forte's set theory, and it can quickly calculate prime forms, interval vectors, and other complex set relations.

Schöler defines the hierarchical approaches as reduction procedures and he then divides them into two main parts:

Hierarchical approaches to music analysis try to apply reduction procedures to music in a sense that different hierarchies of musical structures show certain dependencies as well as, on a high abstraction level, large-scale relationships (especially melodic and harmonic relationships). The basis for hierarchical approaches to music analysis is twofold: linguistic methods, especially those from the structuralistic grammar. Regarding to those two main approaches,

¹⁴ Schöler, Nico. "On Classifying Computer-Assisted Music Analysis," *Computer-applications in music research: concepts, methods, results*. (Frankfurt am Main: Peter Lang, 2002), 129

“hierarchical approaches” can be divided into “transformational analysis” and “Schenkerian analyses”. Both methodological approaches comprise different abstraction levels, which can be obtained by applying certain abstraction rules.

Hierarchical analysis may be considered a second-level analysis after the statistical and information-theoretical methods, which the analyst should engage more with their determination of materials in the process. Where the statistical and information-theoretical methods focus on “what it is,” the hierarchical method focuses on “how it is”. We will further explain these methods in the following chapters.

Spectral analysis is more associated with performance-based analytical methods. The spectrum of pure sound is the focus, and harmonic structure is generally analyzed. This type of analysis has become one of the most favored methods of electro-acoustic works that involve real-time processing. Impressive results have proven the success of such an approach in live performance with electronics. Moreover, some composers have adopted this method for the basis of their compositional process, which has been described as “spectral music” and has become one of the important aesthetics of twentieth-century music. Notable composers of this category include Hugues Dufourt¹⁵, Gerard Grisey, Tristan Murail, Péter Eötvös, Joshua Fineberg, Magnus Lindberg, Kaija Saariaho, Phillippe Leroux, Phillippe Hurel, and Julian Anderson.

Cognitive and artificial intelligence approaches are rather new methods that were not widely recognized until the end of the twentieth century. The concept and process have been described by Schüller as:

Computer-assisted approaches of music analysis that draw on cognitive research and artificial intelligence use computer systems to simulate functions that are usually associated with human intelligence. Those functions include reasoning, learning, and self-organization (or self-improvement). Artificial intelligence approaches can exist in forms of neural networks (net-like

¹⁵ Dufourt first initiated the term in his article in 1979.

connections of units [neurons]) as a class of dynamic systems, music theorists are trying to simulate the architecture of the human brain. Activities in single units of this network entail changes in the whole system. On the contrary, the goal of expert systems is to solve problems by drawing inferences from a knowledge base acquired by expertise; expert systems process information pertaining to a particular application and perform functions in a manner similar to that of a human who is an expert in that field.

Each analytical method has its advantages toward some aspect of a musical analysis. Therefore, a combination of two or more of these methods may improve the analysis and offer a more thorough understanding of a musical work or performance. In Jan LaRue's statement quoted above, he points out a crucial fact, the importance of human involvement in a computational analysis process. Traditional methods rely on the intelligence of the analyst, which is true for computer-based analysis as well.

Classical music of the twentieth century may be described as kaleidoscopic. Many new styles were developed over the course of the century. One of the most significant revolutions was the dissolution of the functional tonal system. Overall, it is a demanding and serious task for contemporary musicologists to deal with such a massive number of styles and the complex information underpinning twentieth-century repertoires. Like other types of artists, composers had already begun to incorporate computers in many ways for their creation, which in turn invites revolutionary change of methodology in contemporary musicology. The traditional analytical methods are less efficient and may require large amounts of time for the analysis of the works of newer styles such as Serialism, Spectralism, New Complexity, Minimalism, Chance, and so on. On the other hand, readers have encountered more difficulty not only in understanding the new works but also the interpretations of musicologists. The multimedia nature of the computer creates new possibilities for the presentation of scholarship by musicologists. For instance, graphical presentation from which readers can visualize the overall structure of a

musical composition is one of the advantages of computer-assisted analysis programs that can save much time over human drawing by hand. To summarize, I adopt the method of computer-assisted analysis for two reasons: first, to improve the speed and accuracy of the musical analysis¹⁶; second, to provide easier access for readers in order to better understand my analytical work. I now turn to the computer program that I have chosen for music analysis: OpenMusic.

History of OpenMusic

The introduction of the OpenMusic documentation describes the program quite successfully:

OpenMusic (OM) is a graphic user interface for the popular LISP programming language. OpenMusic is just that: open. It was not created for any one task but rather as a dynamic environment which you gradually adapt to your work. This flexibility is the appeal of OM: Composers can use OM to refine aspects of their musical language requiring computation without resorting to cumbersome code or calculating by hand; Musicologists can use OM to perform analytical computations on musical material (in the form of notation or MIDI files); Functional programming lovers can enjoy one of the best graphic programming interfaces developed to date, independent of its musical features. OM was and continues to be written by Carlos Agon and Gérard Assayag at Ircam. It follows on the heels of PatchWork, a piece of music software previously developed at Ircam by M. Laurson, C. Rueda and J. Duthen, with contributions by C. Agon and G. Assayag¹⁷.

Before we delve into the fascinating world of OpenMusic, it is essential to introduce the background and brief history of the program.

OpenMusic was first developed at the Institut de Recherche et Coordination Acoustique/Musique (IRCAM) during the early 1990s. The institution was founded in 1977 by renowned conductor and composer Pierre Boulez and is closely associated

¹⁶ A portion of an analysis is less intellectual but necessary which can be alternately replaced by using computers. For instance, the counting of pitch sets.

¹⁷ OpenMusic Documentation, 20

with Centre Pompidou in Paris. Before the establishment of IRCAM, the musical world had changed following the invention of the computer and several computer music programs. Hiller, Xenakis, Barbaud, for example, had prepared the foundation for developing more advanced programs. The Formes environment was developed at IRCAM around 1984, which was written in a manner similar to OpenMusic—that is, as an object-oriented program using Le_Lisp language. In “Computer Assisted Composition at IRCAM: PatchWork & OpenMusic,” the authors described the system as follows:

It included a set of classes intended to help the description of processes evolving in time and connected by recursive hierarchical relations. For example, a parent process could distribute data over time to child processes, while receiving information computed by its children during their execution. This model favored the construction of complex sound textures while minimizing the programming task. The output was a set of control signals for software synthesizers.

Even though the system shares common ground with OpenMusic, it was initially designed for the high-level control of sound synthesis. The next development is the Crime environment, which was considered

the first attempt at IRCAM to realize a general CAC [Computer-Assisted-Composition] environment where the user could handle musical abstractions and easily program musical formalisms. As a significant innovation, the output was no longer a set of signals, but rather a symbolic description of a musical score which could also be printed in common music notation. Specialized formal sublanguages were made available to composers which could then be used to define rhythmic patterns, harmonic progressions, polyphonic interrelations and so on¹⁸.

G. Assayag and composer C. Malherbe are the main contributors of the Crime

¹⁸ Agon, Carlos, Gérard Assayag, Mikael Laurson, Camilo Rueda. *Computer Assisted Composition at Ircam: PatchWork & OpenMusic*, <http://recherche.ircam.fr/equipements/repemus/RMPapers/CMJ98/>.

environment, which was written in Le_Lisp on a digital Vax minicomputer.

In the early 90s, M. Laurson, J. Duthen and C. Rueda worked on the PatchWork (PW) project, which is a visual interface to the Common Lisp Language. PW is considered a tool for computer-assisted composition that provides graphical programming capacity for its users. OpenMusic is the superset of PW, in which advanced objects such as *Maquette* and the capability of user-designed objects are introduced. Both PW and OM depend on *Patch*, which is “a layout of visual elements (views) in a window”.¹⁹ OpenMusic has been supported by developers such as Bill Schottstaedt at CCRMA for the music notation in OpenMusic, Yann Orlarey at GRAME for the MidiShare, and composers such as Joshua Fineberg, Claudy Malherbe, Mikhail Malt and Tristan Murail.

Elements of OpenMusic

In order for the reader to understand analysis that is realized in the OM environment, I shall introduce the structure and basic concepts of the program. First of all, we should keep in mind that OM is based on an object-oriented and visual programming language. These objects are represented by graphical icons, which can be interconnected to realize various tasks defined by users. The most current version is OM 6.1, which is compatible with MacIntel and PPC or Windows XP and Vista. When OM is opened, two windows will appear: the workspace and the listener. The workspace is the upper space, which may contain three types of objects: patches, maquettes, and folders. In the listener window, the operation and result of the evaluation of functions will display below. It also reminds the user if an error has occurred.

¹⁹ Ibid.

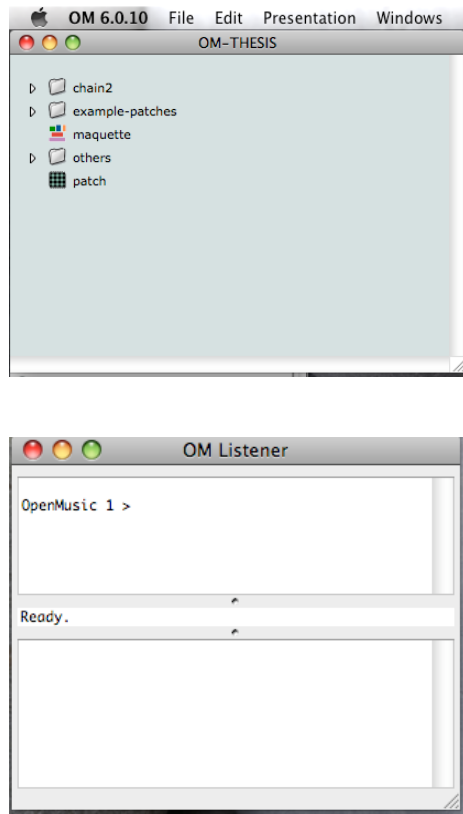


Figure 1
OM *Workspace* and *Listener*

Among the objects in the workspace, a patch is the most basic unit of OM programming. Inside a patch, three other types of objects can be used. The first of the three is Function, which can perform calculation of the inputs and outputs of the function. There are many standard function objects in OM environment such as *OM+*, *nth-random*, *remove-dup*, etc. Advanced users can also create their own functions. The second type is Class, which represents materials or results that can be put in the boxes of Class Objects such as *notes*, *chords*, *sound*, and so on, that are defined as OM classes. The third type of objects is a Patch, which can be used as sub-patch in other patches and its performance may equal to functions. (Please refer to Fig.2 shown below).

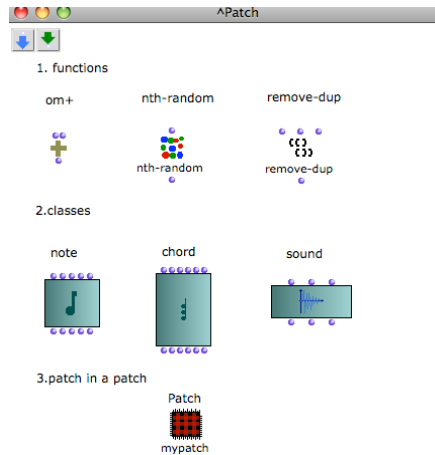


Figure 2
OM *Patch* editor

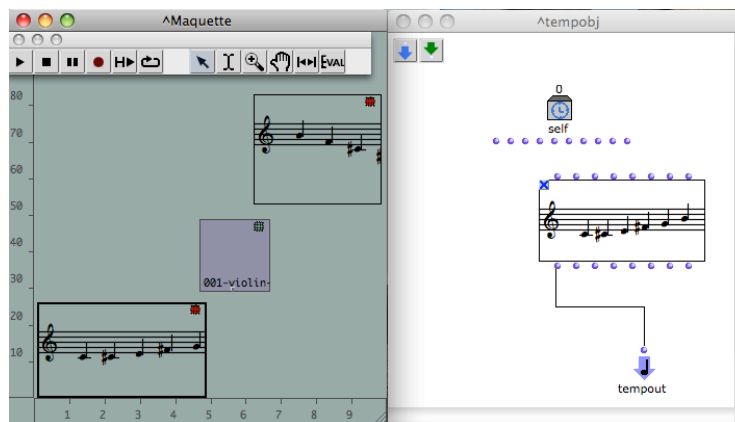


Figure 3
OM *Maquette* editor

Maquette is a French word that can be translated as “model” or “sketch”.

Similar to patch, it functions as a container. However, it is a special object that incorporates a time element. Any objects may be dragged into the maquette, and it also contains a special object called Temporalbox, which can only be found in the maquette. **Figure 3** illustrates the *Maquette* on the left and the *tempobj* on the right, which can be opened by clicking one of the boxes in the *maquette*. OM users can organize the musical materials in the *maquette* following the time structure of their

work, which is one of the significant features of OpenMusic.

Another very useful feature is the OM library, which contains standard OM objects categorized by their functions in eight folders such as *om kernel*, *basic tools*, *score*, *midi*, *audio*, *mathstools*, *constraints* and *omchroma*. It also includes many user libraries that are extended libraries and contributed by various OM experts around the world. The factory user libraries include *chroma-classes*, *esquisse*, *lz*, *modalys*, *morphologie*, *om-supervp*, *om2csound*, *om_asx*, *om_diph*, *omalea*, *omchaos*, *omcs*, *ompitchfield*, *omrc*, *omtimepack*, *profile*, and *repmus*. For analytical purposes, I imported a few more libraries including my own library: *fangman*.



Figure 4
OM Library

The above introduction to OpenMusic is very brief and only for the purpose of understanding the examples of my OM analysis in the following chapters. For detailed information about OpenMusic, one may check out the online documentation at [http://support.ircam.fr/forum-ol-doc/om/om6-manual-v1/co/OM Documentation.html](http://support.ircam.fr/forum-ol-doc/om/om6-manual-v1/co/OM%20Documentation.html).

CHAPTER II

LUTOSŁAWSKI AND HIS MUSIC

Lutosławski's Life

Witold Lutosławski was born in Warsaw on January 25, 1913 to landowning parents. His father, Józef Lutosławski, was executed in 1918 during the First World War due to his political activities against the Russians. This family tragedy remained in Lutosławski's painful memories. When he was six, his mother, Maria Lutosławski, brought him to study piano with Helena Hoffman, a well-known teacher in Warsaw at that time. At the age of thirteen, he began to learn the violin. And just one year after, he entered the Warsaw Conservatory as a part-time student, while continuing piano lessons with Józef Smidowicz at Stefan Batory *gimnazjum*. But soon he suspended his studies at the Conservatory due to a conflict with his violin classes. In 1931, Lutosławski was accepted to the University of Warsaw to study mathematics. One year after, he re-entered the Conservatory to study composition and analysis with Professor Witold Maliszewski, who had been a pupil of Rimsky-Korsakov and Glazunov. Maliszewski's approach to the analysis of form in the music of Haydn and Beethoven and other composers of the Viennese Classical period had certain influences on Lutosławski's treatment of large-scale forms. In 1933, he abandoned his study in mathematics at Warsaw University in order to concentrate on music at the Conservatory, where he graduated in 1937 in composition and one year earlier in piano.

Although Lutosławski intended to go to Paris to continue studying composition, the Second World War ruined his plan, so instead he joined the army to defend his native country of Poland from attacks by Germany. During the war, he was once captured by the Germans but soon after he was able to escape from the detention camp and walked the long way back to Warsaw. Due to the German occupation in

Poland from 1939 to 1945, Polish cultural activities were largely forbidden. He supported himself and his mother by playing in cafés in the capital. At that time, Lutosławski and his fellow composer Andrzej Panufnik formed a piano duet and performed hundreds of works they transcribed for two pianos. One of the most performed works of Lutosławski, the transcription for two pianos from Paganini's Twenty-fourth Capriccio, was created during this early period, which is the only one of his early pieces to have survived after the uprising of the Polish underground army in Warsaw in 1944.

It took Lutosławski six years to complete his First Symphony in 1947, but it was disapproved and called "formalist" by government authorities after they heard the work performed at the inaugural concert of the Chopin Competition in 1949. The symphony was not performed again in Poland until ten years after that incident. Another important work of this period is the Concerto for Orchestra, which was requested in 1950 by conductor Witold Rowicki for the Warsaw Philharmonic Orchestra. It was completed in 1954 and performed in the same year. The success of the Concerto for Orchestra won many honors and prizes for Lutosławski that had placed him as one of the leading composers of his generation in Poland.

After finishing the five *Dance Preludes* in 1954, which was the last work in which Lutosławski adopted folk material, he began to make use of the twelve-note pitch organization in his new works²⁰. He employed the technique for the first time in the set of Five Songs, which was premiered in its original version in 1959 and in the orchestral version in February 1960. *Musique Funèbre* (1954-8) was composed in memory of Béla Bartók on the tenth anniversary of his death. It won a first prize from UNESCO in 1959. This piece is highly regarded for its use of horizontal interval pairing, developed in the form of a twelve-tone theme. While Lutosławski was still

²⁰ It differs greatly from Schoenberg's twelve-tone technique.

working on his last postludes in 1960, hearing a radio broadcast of John Cage's *Concerto for Piano and Orchestra* became a key inspiration for his personal version of Chance technique, which was employed largely in his works of the middle period and partially in the late works. Limited aleatory perhaps more explicitly describes this technique, which means "a procedure whose broad outcome is defined, but whose details depend upon chance."²¹ *Jeux venitiens* is among the most complex pieces of his in which aleatory technique is employed significantly. Other notable works of this period utilizing aleatory technique include *Trois poèmes d'Henri Michaux* (1961-3), which Lutosławski himself conducted the premier at the Zagreb Music Biennale in May 1963. In the next year, he was honored with the State Prize the second time in Poland.

Among Lutosławski's works, a large portion is devoted to orchestral works. Among his chamber works, the String Quartet (1964) is highly regarded as one of the best quartets in the twentieth century. The aleatory technique is more heavily applied in many aspects. The quartet's two-movement form with the introductory first movement and main movement as the second movement marks the beginning of his personal approach to the two-movement large-scale form. It was commissioned by Swedish Radio and premiered by the LaSalle Quartet in Stockholm in March 1965. The next piece he composed is a vocal work, *Paroles tissées*, which is dedicated to Peter Pears and was premiered at the Aldeburgh Festival in June 1965. After he discovered the chance technique, he began to compose the Second Symphony, in which he employs Chance a great deal. This work was commissioned by North German Radio in Hamburg; the second movement, 'Direct,' was premiered in October 1966 under the direction of Pierre Boulez. The first performance of the complete two movements was given by the Polish Radio Symphony Orchestra with Lutosławski

²¹ Rae, *The Music Of Lutoslawski*, 76.

conducting in June 1967 in Poland.

In 1966, Lutosławski signed a contract with the English publisher Chester Music in London, which secured his authorship and which allowed him to compose less functional music²². In the same year, he received the Alfred Jurzykowski Prize from New York and was elected an Honorary Member of the Freie Akademie der Künste in Hamburg. By the year of 1968, he was able to complete a new orchestral work, *Livre pour orchestre*, which was commissioned by Hagen, a city in Germany, through the music director Berthold Lehmann in 1962. Lehmann conducted the premier with the Stadtisches Orchester in November 1968. A four-movement form is used, in which the first three movements lead to the climax in the final movement.

One of Lutosławski's most admired works, the Cello Concerto, was commissioned by the Royal Philharmonic Society and premiered by Mstislav Rostropovich in October of 1970 in London. This piece is particularly notable for its theatrical influence and his employment of drama applied to music. While he was working on the next piece, *Preludes and Fugue* (1970-2), he made a trip to the United States for an honorary doctorate of music given by the Cleveland Institute of Music in 1971. In the same year, he has also received the Prix Maurice Ravel and a special cultural award from the French President. There are seven preludes that can be played in any order. All the overlapping beginnings and endings are planned with the same group of instruments, and the pitch materials are divided into two complementary hexachords. This is probably one of the earliest examples of the chain technique, which I will explore later. This piece was commissioned by Mario di Bonaventura, to whom he dedicated the piece, and it was premiered by the Zagreb Radio/TV Chamber Orchestra under the commissioner's direction in October 1972 in Graz during the

²² For many years Lutoslawski composed incidental music for theatres and radio plays, children's songs for radio broadcasts

Styrian Autumn Festival.

Before his next piece, *Les espaces du sommeil* (The Spaces of Sleep) for baritone and orchestra (1975), he had already composed two vocal works, *Trois poèmes d'Henri Michaux* and *Paroles tissées*, in which he used surrealist poetry as texts. This piece stands as one of the most beautiful sonorities ever created by the composer, which offers listeners imagination and enjoyment. The first performance was not given until April 1978, conducted by the composer with the Berlin Philharmonic Orchestra. His next piece, *Mi-parti*, is like *Les espaces du sommeil*, which uses the French language as its title. It was commissioned by the Amsterdam Concertgebouw Orchestra, which gave the first performance under the direction of Lutosławski in October 1976. Despite the successful performances and well-received feedback of the pieces composed during this time, Lutosławski was still unsatisfied with his techniques. Nevertheless, he moved on to continue working on the Third Symphony and the Double Concerto and to fulfill the next commission, *Novelette* (1978-9). The title in German means “sketch”. Each of the five movements has its own abstract title: Announcement, First Event, Second Event, Third Event, and Conclusion. The music aptly follows the titles, such that the first four movements lead to the climax in the last movement. This piece was commissioned by Rostropovich and the National Symphony Orchestra and conducted by Rostropovich with NSO in January 1980. It marks the end of his middle stylistic period, and he was about to develop a new technique that applies to his next pieces.

The cause of his intention to develop new techniques stemmed from his dissatisfaction over the obscure boundaries between the foreground and background layers. A solution he later found was to simplify the harmony: instead of the large deployment of twelve-note chords as harmony, he adopts fewer notes for most of the music and reserves the dense harmony with twelve-note chords for the important

arrival points or climaxes of a work. Other features of his late style include an emphasis on the melody, reduction of the aleatory technique, use of conventional meters in significant portions, the evocation of Baroque music and his own earlier works before 1960s, and completions of projects that he intended to compose in his youth, such as the Piano Concerto.

Epitaph marked the beginning of this new era. The piece was commissioned by the oboist Janet Craxton in the memory of her husband, and it was premiered in London in January of 1980. The structure of the piece once again utilizes the interplay of the refrain and episodes. The simplified harmony is so notable that one could not find any twelve-note chord in the whole piece. Double Concerto is among the two works of his (the other is Symphony No. 3) that took him a long time to complete and which contain features of both periods before and after 1980. The piece is scored for oboe, harp, and chamber orchestra, and was commissioned by Paul Sacher to be played in a premier by Heinz Holliger and Ursula Holliger as soloists with Collegium Musicum under Sacher's direction in August of 1980. Another petite piece he has composed during this time is *Grave* (1981), which is in memory of his long-term friend, Stefen Jarocinski, a Polish musicologist and critic who died in May of 1980. The piece is scored for cello and piano and was first performed at the National Museum in Warsaw in April 1981. Along with *Epitaph*, it serves as an experimentation that enabled Lutosławski to discover new ways of manipulating materials.

It is worth noting that many of the works by Lutosławski took more than a year to finish. But probably the most extreme case is his Symphony No. 3, which spanned ten years or more until its completion in January 1983. This piece stands as the most monumental of all his works because of its mastery of manipulating timbres and large-scale form; it also highlights the quintessential features that appeared in his mature and

late periods. The premier of the work was given by Sir Georg Solti and the Chicago Symphony Orchestra in September of 1983. In the same year, Lutosławski also worked on *Chain 1*, which is the first of the three pieces with the title Chain in English (*Lancuch* in Polish). It was commissioned by the London Sinfonietta and premiered under the direction of Lutosławski in October 1983. It is the same year in which martial law was declared in Poland and the Solidarity movement spread through out the nation. During this time, Lutosławski declined to appear publicly in concerts, on state media, or for any occasions in Poland. He was awarded the Solidarity Prize in 1983 to acknowledge his support of the dissident position. In the following year, Lutosławski completed another chamber work, *Partita* for violin and piano, which was commissioned by the St. Paul Chamber Orchestra and first performed in January of 1985. In the same year, he also completed the second chain piece, *Chain 2*, which comes with a subtitle “Dialogue for violin and orchestra.” It was commissioned by Paul Sacher and was premiered in January 1986 by Anne-Sophie Mutter on violin with the Collegium Musicum under the direction of the commissioner. Sacher thereafter commissioned *Interlude*, intended to be performed between the orchestrated version of *Partita* and *Chain 2*. The complete cycle of performance with these three pieces together was given by Mutter with the Munich Philharmonic Orchestra under Lutosławski in January 1990. The last piece with the chain title is *Chain 3*, which was commissioned by the San Francisco Symphony Orchestra and premiered by Lutosławski conducting the SFO in December 1986. While he was consistently busy composing, numerous awards followed to honor him; most notably the International Record Critics Award and the Gold Medal of the Royal Philharmonic Society.

As a pianist himself, Lutosławski had long wished to compose a piano concerto. With the strong interest to compose a piece for pianist Krystian Zimerman, he completed the concerto in 1988 for the Salzburg Festival. The first performance

took place in August by Zimmerman with the Austrian Radio Symphony Orchestra under the baton of the composer. A repeated performance of the Piano Concerto along with his Third Symphony took place at the Warsaw Autumn Festival in September in the same year. The last vocal piece he composed is once again based on the poems of Robert Desnos. The texts of *Chantefleurs et Chantefables* were chosen from a collection of sixty short poems by Desnos with the same title, from which Lutosławski selected nine representing characters: four creatures and five flowers. It is a song cycle scored for soprano and orchestra, and was first performed by Norwegian soprano Solveig Kringleborn, with the London Sinfonietta in August 1991.

Lutosławski conducted the premier of the Fourth Symphony with the Los Angeles Philharmonic Orchestra in February of 1993, commissioned by the orchestra in 1989. The two-movement form is reminiscent of the Second Symphony, a pattern Rae says functions “as a kind of Introduction and Allegro”.²³ The piece that concluded his artistic career was *Subito*, a short piece for violin and piano, which was requested for the Indianapolis International Violin Competition. The sixteen semi-finalists of the violin competition played the piece during the four days from September 16 to 19 in 1994. In celebrating his eightieth birthday, numerous concerts took place in Poland, the United States, England, France, Finland, Italy, and all over the world. He was awarded an honorary doctorate by the University of Strasbourg, and the Polar Prize for Music by the Swedish Royal Academy of Music, among many others. After returning from his visit to Japan to receive the Kyoto Prize, he was sent to the hospital following a bout of fatigue, and his physician discovered an unusual growth under his left arm. However, the operation did not succeed in resisting the cancer, which spread quickly and soon led to death. He was buried near the graves of his friends and colleagues in Warsaw.

²³ Rae, *The Music Of Lutoslawski*, 245.

Lutoslawski's Style Periods:

We can summarize Lutosławski's musical movement by scoring these works into three style periods. His primary activity as a composer spans fifty-eight years from *Piano Sonata* (1934) to *Subito* (1992). According to Steven Stucky²⁴, it can be divided loosely into: early, middle and late periods²⁵.

1. The early period spans the years 1934 to 1955, which can be then divided into two small periods: the neoclassical and utilitarian periods. Notable works such as *Lacrimosa* (1937), *Symphonic Variations* (1936-8), *Paganini Variations* (1941), and *Symphony No.1* (1941-7), associate more closely with the neoclassical period. Besides some serious works such as *Overture for Strings* (1949), *Little Suite* (1950; 1951), *Concerto for Orchestra* (1950-4) and *Dance Preludes* (1954; 1955; 1959), he composed many incidental, functional pieces in order to earn a living; these can be included in the utilitarian period. In general, works of the early period can be seen as "tonal", and many adopt Polish folk materials.
2. The middle period can also be divided into sub-periods: a transitional period spans the years 1955 to 1960, with works that began to abort the allusion to folklore or functional music and during which some unique techniques were being created. Notable works from this period include *Illakowicz Songs* (1956-7), *Musique funèbre* (1954-8) and *Three Postludes* (1958-60). The mature period began the year of 1961 when his first indeterminacy work *Jeux vénitiens* was completed until the year of 1979. Some of his best known works were composed during this time, such as the *String Quartet* (1964), *Cello Concerto* (1969-70), and *Les Espaces du sommeil* (1975). His use of twelve-note chords and complex harmonic structure

²⁴ Steven Stucky indicates Lutosławski's three stylistic periods in his article "Change and Constancy: The Essential Lutosławski" which is included in the book *Lutosławski Studies* edited by Zbigniew Skowron.

²⁵ Please refer to the table included in the Appendix at the end of this paper.

are particularly characteristic of this period.

3. The last period, which Stucky calls the late period, includes the three chain pieces (1983-1986), Symphony No. 3 (1972-83), Piano Concerto (1987-8), Symphony No. 4 (1988-92), and ends in 1994, with the composer's death. Melody and harmony play equal roles, and twelve-note chords are employed much less than in the works of the middle period.

Lutosławski's Techniques

It is not easy to catalogue definitively the many compositional techniques that Lutosławski employed or created anew, since there were continuous changes and emphasis during the long period of his creative outputs. In order to be clear, I try to fit them into several categories that are common in music, such as melody, harmony, counterpoint, texture, rhythm, as well as music, structure, and form. Please note that one should not pick one out and assume it covers all, because some of the techniques exist only in certain works at a certain period. Therefore, it is important to note the background circumstances of these techniques.

1. Melody:

Melody is considered relatively more important in his works of the early and late periods. His manipulation of pitches for a melody is particularly interesting in the works of his late period, which often draws from two or three interval classes and offer unique sound character. **Example 1** displays the opening passage of the Cello Concerto (1969-70), which contains mainly three types of interval classes 5, 6, and 2. As shown in the lower part of example 1, I use a simple OM patch to get the interval relations of this melody²⁶.

It is worth noting that this type of melody is called “the *dolente* melody” by

²⁶ I will explain the OM patch in the later chapters.

Rae. The characteristic features of this melodic type include “grace-note embellishments and mostly emphasizes a pair of intervals such as 2 and 3, or 1 and 3, sometimes with a larger falling interval (often 5) as a cadential gesture at the ends of phrases”²⁷. The *dolente* melodies can be found in many of his works of the late stylistic period. I provide an example below (**Example 2**), here played by the solo violin at the beginning of the third movement of *Chain 2*.

Another feature of his treatment of the pitch set also involves self-transposition of pattern, which often appear as repetitions of a pattern and involve limited interval classes. Shown in **Example 3** below is a passage from *Grave* where the melodic line on the cello is composed with transpositions of the row with limited intervals (in this case, ic 2 and 5, 1 and 6). The colored icon named *forinterval-h* is an OM object, which obtains the horizontal interval relations after evaluation. I will explain this object in greater detail in the next chapter.

WITOLD LUTOSŁAWSKI (1970)

f1 = ca 60

Vcllo

p indifferente

Cello

pp

in poco buffo ma con eleganza

OM => (-3 -5 6 5 2 5 -5 6 5 2 -5 6 5 2 -5 6)

forinterval-h

Example 1
Opening passages of the Cello Concerto

²⁷ Stucky, “Change and Constancy” (*Lutoslawski Studies*), 138.

forinterval-h

OM => (-1 -1 2 -1 -1 2 -1 -1 2 -1 0 -1 -1 -3 -5)

Example 2

Opening passages of the third movement in *Chain 2*

forinterval-h

OM => (5 2 -1 5 2 2 -1 -6 1 -1 6 1 -6 1 1 6 -1 2 2 -5 -1 2 5 -2 5 2)

Example 3

Opening cello passage in *Grave*

2. Harmony

Harmony stands out as the most important aspect for understanding Lutosławski's music. Among his early works, polychords can be found in *Symphonic Variations*, *Paganini Variations*, etc. Later he frequently employs twelve-note chords, constructing them in different layers as what Rae calls "chord-aggregates." These chords, which are especially frequent in his middle period, are also structured with vertical symmetry. His use of twelve-note chords is largely reduced in the works of his late style, often appearing mainly at the climax or at the end of a section. Another feature of these twelve-note chords is similar to the construction of the melodic materials in that limited intervals are employed for the twelve-note chords. An illustration of this feature can be found in **Example 4** below, from the second movement of *Chain 2*. Piccolo flute, flute 1, oboe 1 and clarinet 1 join to play a four-note chord 3+5+3; violins I play another four-note chord in divisi 3+4+3; violins II and violas join to play the third four-note chord 3+4+3, which later is replaced by the fourth four-note chord played on violoncellos and violas 4+3+4. The piano doubles these chords either in their original form or in rotations.

Complementation of pitch material can be found in works particularly of his middle and late periods. It appears in different layers that can be defined as harmonic background and foreground and by different instrumental groups. One example of complementary pitch organization is the use of complementary hexachords, which can be found in works such as *Preludes and Fugue*, *Musique funèbre*, String Quartet as well as Symphony No. 2 and Cello Concerto. **Example 5** illustrates the transpositions of the hexachord found in the Cello Concerto.

The image shows a musical score for rehearsal 48 of *Chain 2*. The score is written for a large ensemble. The top section includes woodwinds: Fl. piccolo (Fl. picc.), Fl. 1 (Fl. 1.), Ob. 1 (Ob. 1.), and Cl. 1 (Cl. 1.). Below these are the percussion parts: trb (trb) and pf (pf). The bottom section includes strings: vni I div. (vni I div.), vni II div. (vni II div.), vlc div. (vlc div.), and vc div. (vc div.). The score is in 4/4 time and features complex chord aggregates and melodic lines. Dynamics include *ff* (fortissimo) and *poco f* (poco forte). There are also markings for *senza sord.* (senza sord.) and *ped.* (ped.).

Example 4

Chord aggregates at rehearsal 48 of *Chain 2*

One of the most important features of his works of the late period is the use of simplified harmonies within a homophonic texture. One typical example is his placement of four-note chords as the harmony, while the melody draws from the complementary pitches up to eight. Lutosławski spoke about the influence of Chopin's chromatic voice-leading on his use of the four-note harmony, where chords connect to each other by shared sustained pitches and move one or two voices at a time. Stucky has discovered that "the several of these [types of four-note chords] are subsets of the octatonic set and that as such they point towards Rimsky-Korsakov, Debussy, Stravinsky, Ravel, Bartók, and Messiaen—and away from Schoenberg."²⁸ **Example 6** illustrates the progression of chords that are played on strings at rehearsal number 53 to 55 in *Chain 2*.

²⁸ Stucky, "Change and Constancy" (*Lutoslawski Studies*), 147,

The image shows a musical score for three staves (1, 2, 3) with a '7 AD LIB.' marking and a 'ca 2nd' marking. Below the staves is a diagram of a hexachord, which is a six-note chord consisting of a major triad and a minor triad sharing a common side.

Example 5

Transpositions of the hexachord at rehearsal 7 of the Cello Concerto

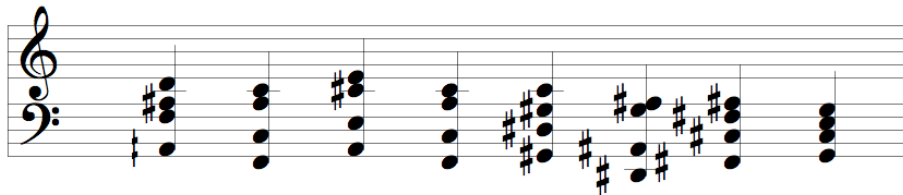
The image shows a musical score for a single staff with a series of chords. The chords are transpositions of the hexachord, which is a six-note chord consisting of a major triad and a minor triad sharing a common side.

Example 6

Strings harmony at rehearsals 53-5 in *Chain 2*

It is obvious that his harmonic language is post-tonal, in-as-much as twelve-note chords are employed throughout works of his mid to late periods. However, one could easily find examples of triad-oriented harmony, especially in the late works; his frequent employment of the perfect fifth, particularly found in the bass-line, is reminiscent of functional tonality. **Example 7** below indicates the harmonic progression played on the woodwinds at rehearsals 24 to 25 in *Chain 2*. They are all

triads with perfect fifths on the bottom. Such organization of chords can be found in many other places in *Chain 2*, as well as other works of his late period.



Example 7

Harmonic progression in the woodwinds at rehearsal 24-5 in *Chain 2*

A feature that is carried out throughout many works from almost all stylistic periods is his organization of harmony that contains both diatonic and chromatic materials separated by instrumental groups or layers. Notable works with this feature are *Postludes No. 1* and *Symphony No. 4*, etc. The top line in **Example 8** indicates the clarinet solo that is chromatically composed. The harmonic chord progression below the clarinet line is the piano reduction of the string harmony that is nearly diatonic.

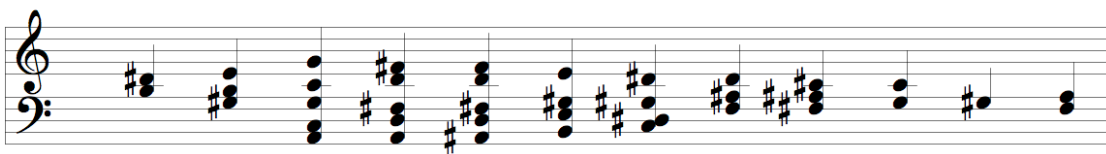
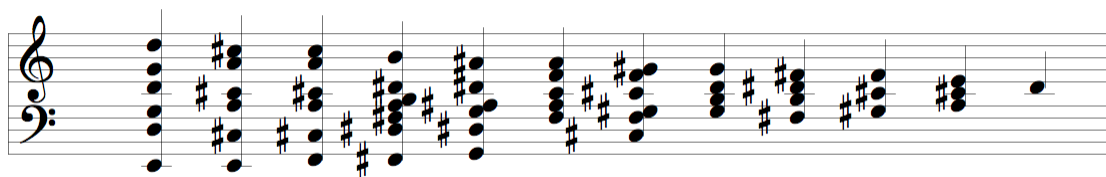


Example 8

Diatonic and chromatic layers in *Symphony No. 4* (beginning to rehearsal 3)

Another characteristic feature of his treatment of harmony is the expansion or contraction of interval classes of chord progressions that are systematically planned.

Example 9 shows an example found in *Chain 2*.



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Example 9

Expansion and contraction of chords of rehearsals 32-3 in *Chain 2*

(49) Tempo I (♩ = ca 108)

vn I
div.
pp

vn II
div.
la meta
fz

vla
div.
fz

vc.
div.
fz

cb.
can sord.
pizz.
pp

can sord.
unbr.
pizz.
pp

cb solo
arco con sord.
p

poco sf

(50)

vc solo
arco con sord.
p

poco sf

pp

cb.
p

attribution
poco sf

pp

poco sf

pp

(51)

poco sf

pp

Example 10

Illustration of the canonic writing in Symphony No. 3

3. Counterpoint

Canonic writing can be found in the works as early as in the 1940s, in the canonic studies as well as in Symphony No. 1, *Musique funèbre*, and Symphony No. 3

(please refer to **Example 10** above). The typical organization for the *ad libitum* passages are represented as microrhythmic cells or “bundled” type of contrapuntal textures.



Example 11

Illustration of the “bundle” type of writing in *Preludes and Fugue*

4. Texture:

One can find cantilena passages in many works of the middle and late periods. According to Steven Stucky, it can be categorized into two types by its textural appearance: “one is the massed cantilena passages in a dense, collective *ad libitum* setting, which often climbs from a lower to a higher register...the other is the outright unison tune on masses strings, unaccompanied.”²⁹ **Example 12** and **13** below illustrates these two types.

A term associated with *ad libitum* sections is “mobile,” which refers to sections with different lengths and instruments that are to be played without concern for the vertical relationships within the instrumental parts. In Lutosławski’s words, “I wanted merely to loosen the time connections and to achieve a specific texture, which we might call a ‘fluid’ texture”.³⁰ **Example 14** is extracted from *Chain 2*, an *ad libitum* passage played on the two flutes and two clarinets. The white triangle sign under the

²⁹ Stucky, “Change and Constancy” (*Lutoslawski Studies*), 138.

³⁰ Kaczynski, Tadeusz. *Conversation with Witold Lutoslawski*. (London: Chester Music, 1984), 12.

rehearsal number 74 is the conductor's sign that indicates the beginning of the first notes of these instruments and then each of the instruments play individually without trying to line up with other lines until the conductor's next sign to end this free section. Such notation is typical and found in most of Lutosławski's scores, particularly in his works of the mid to late periods.

The image displays two systems of musical notation for a string ensemble. The first system consists of staves 1 through 7, with staves 4 and 5 labeled 'vni' and 'vna' respectively. The second system also consists of staves 1 through 7. The notation includes various musical symbols such as notes, rests, and dynamic markings like 'poco rit.', 'dim.', 'p', 'f', 'molto cantabile ed espressivo', 'acc.', and 'al tempo I'. The staves are numbered 1 through 7 on both systems.

Example 12: *Preludes and Fugue* (third Prelude)

Epilog • Epilogue

5

250

Violin I: sul sol

Violin II: sul sol

Viola I: sul sol

Viola II: sul sol

Violoncello I: sul sol

Violoncello II: sul sol

Contrabass: sul sol

pp

Example 13

Strings unison in the Epilogue movement of *Musique funèbre*

74

1. p

2. p

1. p

2. p

p

Example 14

Ad Libitum passage at rehearsal 74 of *Chain 2*

Finding these multi-layers is essential for the textural analysis of Lutosławski's music. This task is particularly difficult for works of the middle period because three or more multiple layers are sometimes constructed, thus increasing the complexity of the works. We may call it “polyphony of textures³¹”.

5. Rhythm:

The use of isorhythm can be found in works such as *Musique funèbre* and *Livre pour orchestre*, in which variations of a set of rhythmic values are achieved by expansion and diminution or other systematic operations. **Example 15** illustrates the isorhythmic planning of the materials for the string section at rehearsal 107 in *Chain 2*. We can see that the beats between each attack of the chords are organized to grow smaller from 5 eighth notes to 1. Similar examples can be found in several other works.

The musical score for Example 15 shows five staves for string instruments: vni I div., vni II div., vle div., vc div., and cb. Each staff contains rhythmic notation with stems and flags, representing eighth notes. Below the staves, a sequence of numbers (5, 5, 4, 4, 3, 3, 2, 2, 1, 1) indicates the number of eighth notes between each attack of the chords.

Example 15

Isorhythmic structure at rehearsal 107 of *Chain 2*

The example of the composition technique called, “limited aleatorism” can often be found in the *ad libitum* passages, where the bar lines and time signatures are omitted and materials are notated without precisely lining up with other concurrent

³¹ Stucky, Steven. *Lutoslawski and His Music*. (Cambridge: Cambridge University Press, 1981), 124.

lines.

6. Structure

Motivic thinking rooted in the music of the classical and romantic eras is among the most constant features of his works across his stylistic periods. One of my favorite examples is the opening motive of the Symphony No. 3, which alludes to Beethoven's Third Symphony, "Eroica". His String Quartet also provides strong impressions because of the opening motive that recurs several times during the piece. Motivic thinking is not only found in the melodic themes, but also in the vertical layers that vary the motive through repetition, inversion or recombination.

In Lutosławski's music, we often find areas where a *pianissimo* section follows immediately after a *fortissimo* climax section, which enhances the dramatic aspect of the music. This practice first appears in the finale of his Symphony No. 1, and later in works such as *Jeux vénitiens*, *Livre pour orchestre*, *Les Espaces du sommeil*, *Mi-parti* and Symphony No. 3.

Another feature regarding the structure is his use of episodes and refrains, in such works as the Symphony No. 2, String Quartet, *Jeux vénitiens*, and *Livre pour orchestre*. He also likes to break up movements with several interludes in between primary sections.

7. Form

Lutosławski's perspective towards musical form has clearly been influenced by his teacher Maliszewski, who proposes four rhetorical characters: introductory, narrative, transitional, and concluding. Many of Lutosławski's works are structured with such a procedure; particularly his large-scale works such as his symphonies are notable examples.

Though the chain technique was deployed mainly in his late works, it can also be found as early as the *Concerto for Orchestra* (1954) and *Musique funèbre* (1958).

Chain technique can be found in his works such as *Grave*, *Chains 1, 2 and 3*, and the Piano Concerto. I will explain this technique in greater details in later chapters.

In addition to the above categories, it is worth noting the influence of Baroque and classical music on Lutosławski. One can find examples of his adaptation of forms such as sonata, ternary, scherzo, or fugue, toccata, canon, pedal point, ostinato, chaconne and passacaglia, etc. One could also find influences of the music from other composers of the nineteenth or early twentieth century such as Chopin, Liszt, Brahms, Ravel, Prokofiev, and Bartók. Another feature of his music is the theatrical influence that applies in some entire works or at some points of a work in order to create dramatic effects (e.g., the Cello Concerto, Symphony No. 3, etc).

As we now have some ideas about Lutosławski and his musical language, we may proceed to the next chapter for an analysis of his most favored work, *Chain 2*, with the assistance of the computer music program OpenMusic.

CHAPTER III

ANALYSIS OF CHAIN 2

Background of *Chain 2*

Lutosławski remarks in the preface to the published score of *Chain 2* about this piece and the chain technique:

I composed *Chain 2* during the years 1984-5. The title of the work relates to its form. Over the last few years I have been working on a new type of musical form, which consists of two structurally independent strands. Sections within each strand begin and end at different times. This is the premise on which the term 'Chain' was selected... In the ad libitum movements and in the ad libitum section of the fourth movement the element of chance plays a part within fixed parameters. This has been a feature of my style since 1960 and always offers new possibilities. However, in the last few years I have been preoccupied more by the shaping of pitch (i.e. melody, harmony and polyphony) than by the organization of time. In my opinion the traditional scale, with its twelve notes, has not yet been fully exploited in terms of harmony. I believe that there are still many possibilities to be discovered, independently from Schoenberg's twelve-tone technique.

Chain technique is a method for constructing musical materials that occurs at the point when two overlapping layers do not begin and end at the same time. This technique enhances the continuity of music and avoids abrupt transitions. Some early examples can be found in the passacaglia section of third movement to the *Concerto for Orchestra* (1950-4) and the Metamorphoses movement of *Musique funebre* (1954-8). Irina Nikolska stressed that "it [chain] primarily enabled him to organize a vast symphonic 'action' in which all the elements of his musical language were more or less interconnected."³² Rae points out an important feature of the chain technique, which is the uniformity of the pitch materials. They often draw from the same kind of interval pairings in order to smooth the transitional process with less awareness of

³² Nikolska, Irina, "Chain Connections in the Late Music", *Lutosławski Studies*. Ed. Zbigniew Skowron (Oxford: Oxford University Press, 2001), 323.

such transition to the ears.

Preparation for an Analysis Utilizing OpenMusic

Explanation of the OM Tools Designed or Adapted for the Analysis

As indicated earlier in the first chapter, the advantage of OpenMusic is its flexibility. Advanced users can create new objects and personal libraries for their own purposes, compositional or analytical. I have designed some simple tools for my analysis of this piece, which I will explain in the following paragraphs. The icon pictures are various kinds of the lovely fortune dolls, which were found from an internet source. I have also adopted OM graph tools, such as the N-CERCLE object for the purpose of illustrating the pitch and rhythmic materials, and the BPF and BPF-Lib objects for displaying the melodic contours.

(1) The *object getprime* is created for the purposes of discovering the prime form of a given list of pitches, which returns from the first outlet of the object. It then returns the Forte number from the second outlet and the interval vectors of the prime form from the third outlet.



As shown in **Figure 5** below, the object *getprime* works on a list of pitches that are extracted from the opening passage played on the solo violin in *Chain 2*. We can observe the result in the OM Listener window, which indicates the prime form of the set of pitches are (0 1 2 3 7 8), the Forte number is |6-Z38|, and the interval vector is <4 2 1 2 4 2>. The object on the left with a circle in it indicates the graphical

presentation of the prime form, in which the eleven points of the circle associate with the eleven numbers of a complete pitch-class set in this case.

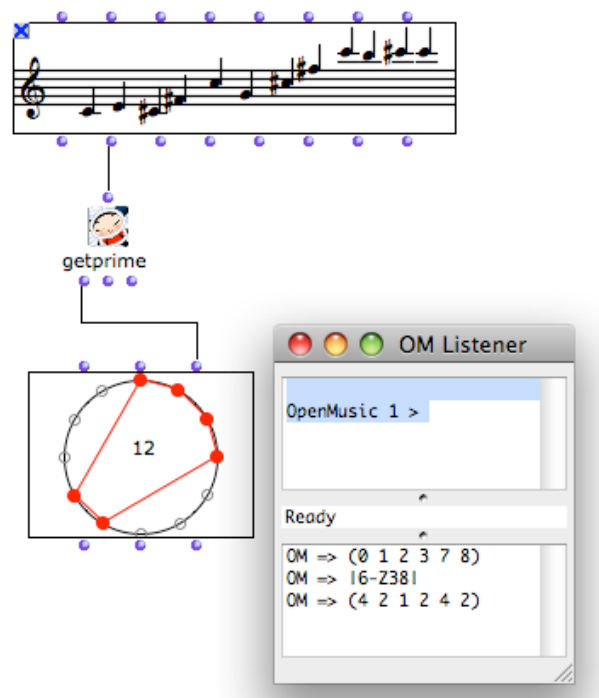
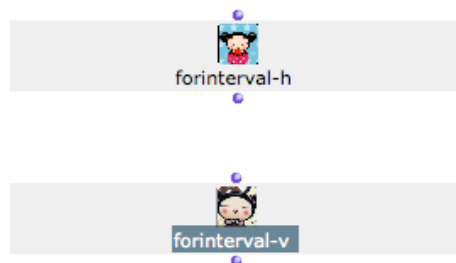


Figure 5
Object *getprime*

(2) The objects *forinterval-h* and *forinterval-v* are designed for discovering the intervals of the given materials. The former returns the intervals of a given melody (horizontal line), and the later returns the intervals of a chord (vertical line).



We use the same melody in **Figure 6** to observe the use of the object *forinterval-h*, which returns “OM=> (2 -1 5 6 -5 6 -1 2 -1)” that indicates the intervals of a

moving melodic line. The negative numbers represent the downward direction, while the positive numbers represent the upward direction. The BPF graphic editor displays the melodic contour of the melody. On the bottom part of this figure, we find a five-note chord that is connected to the object *forinterval-v* and the result OM=>(6 7 6 7) indicates that it is a symmetrical chord with a pair of interval classes 6 and 7.

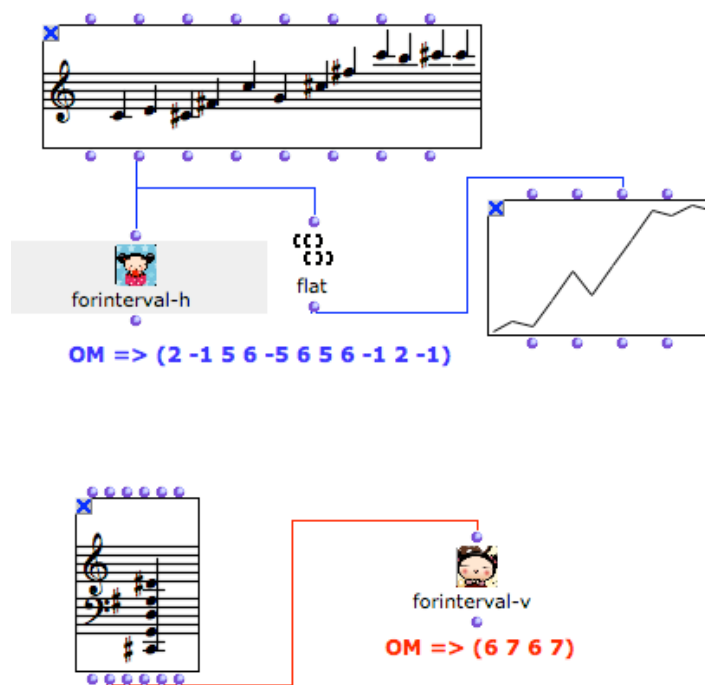


Figure 6
Objects *forinterval-h* and *forinterval-v*

- (3) A melody is often created with repetitions of a set of pitches and the object *sortremo* was created for finding the original set without these repetitions. **Figure 7** below is an illustration of the object *sortremove*. We can see that the object takes out the repetitions and then reorganizes the pitches from the lowest to the highest registers.

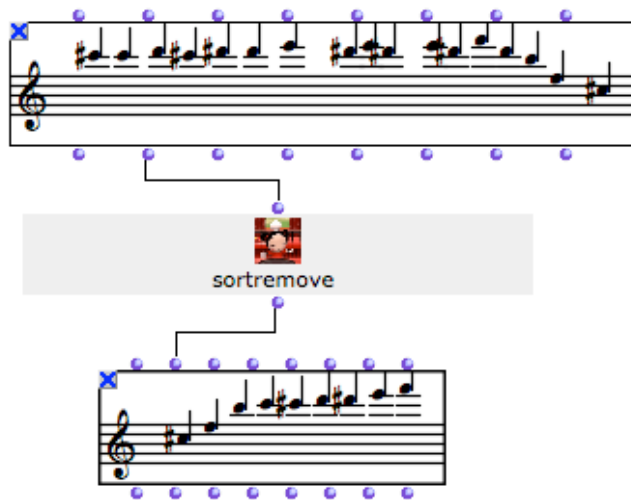


Figure 7
Object *sortremove*

- (4) The objects *range-sort1* and *range-sort2* are similar to what *sortremove* does to a group of pitches. They take out the repetitions first but then sort the pitches within an octave, whereas the *sortremove* does not change the original registers of the pitches. Another significant difference between the two is that *sortremove* will not concern the same pitch in different registers. For instance, C#4 and C#5 remain in the result shown in **Figure 8**, whereas both *range-sort1* and *range-sort2* take out any repeated C# in any registers.

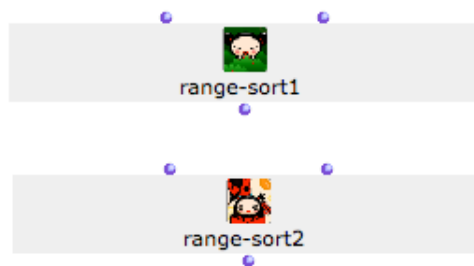


Figure 8 indicates the different results that return from the objects *range-sort1* and *range-sort2*. The former returns a sorted group of pitches that begin from the optional *nth* number of pitches. Here on the left side of this figure, we put 0 that asks

for the minimized set to begin from the first pitch of the original melody, so it begins at C#6. The object *range-sort2* in the middle part of the example has a default value 0, which begins from C4, but it is possible to begin at any pitch by choosing the *nth* rotation number on the second inlet, such as the number 1 shown on the right part of the figure.

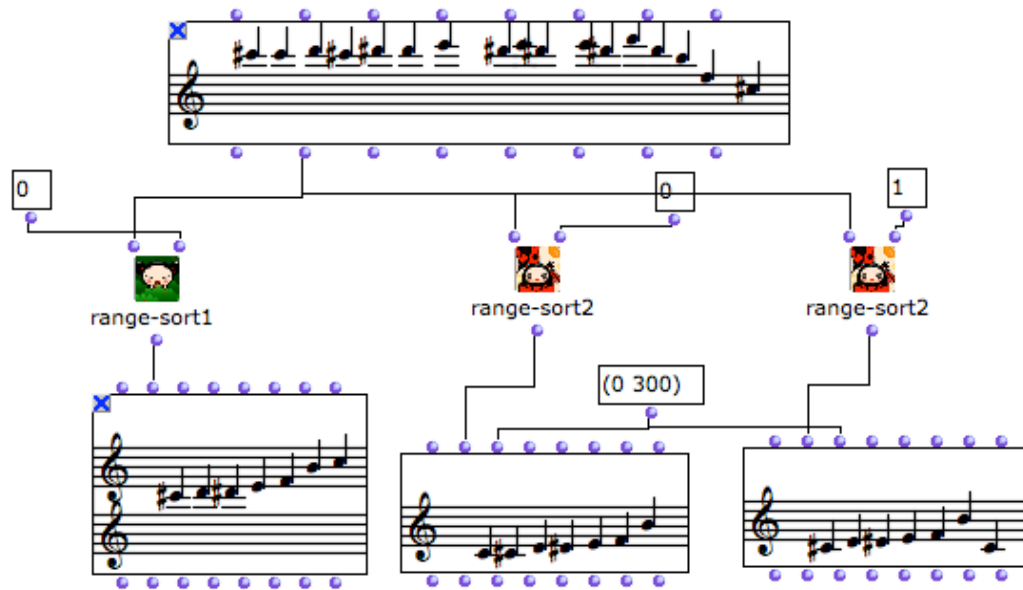
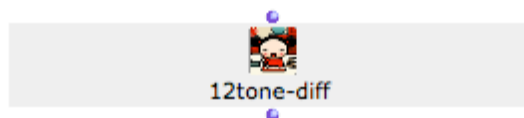


Figure 8
Objects *range-sort1* and *range-sort2*

- (5) The object *12tone-diff* is designed for the purpose of finding the complement of a given set of pitch materials. **Figure 9** indicates the two types of materials, which *12tone-diff* may calculate the missing pitches within a twelve-tone scale. The first set of pitches is displayed in a horizontal line, and the second set of pitches is shown vertically as a chord.



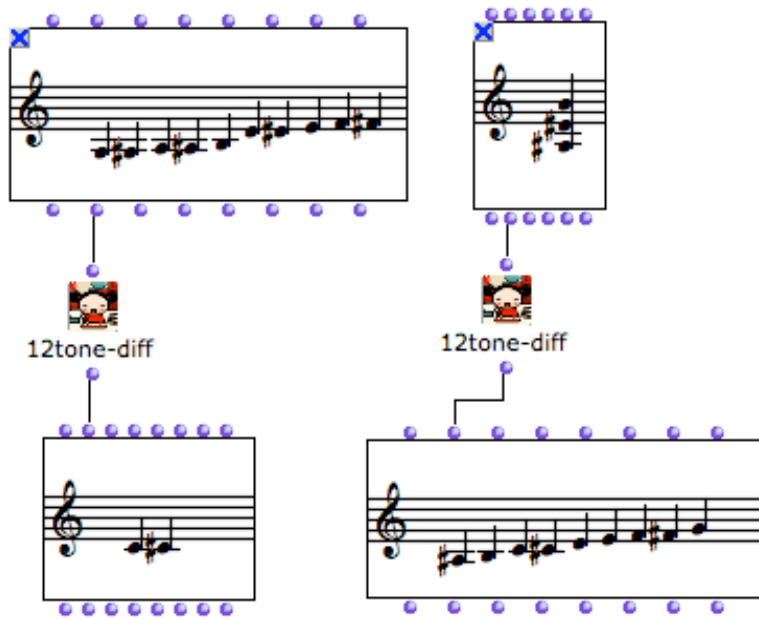
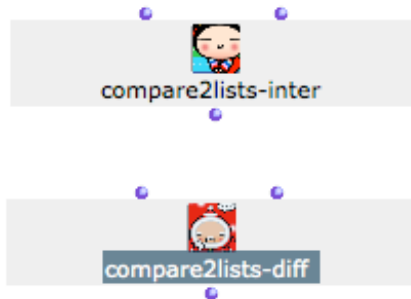


Figure 9
Objects *12tone-diff*

(6) The two objects *compare2lists-inter* and *compare2lists-diff* are both designed for the comparison of two lists of pitches. The object *compare2lists-inter* takes two lists of pitches and returns the pitches that are shared by both lists.



We can see from **Figure 10** that the two given lists of pitches share only one pitch that is D4. It is important to note that the result of *compare2lists-diff* provides the pitches of the list that connects to the first inlet but not included in the second list while comparing two lists. Therefore, we find two different results in the figure below due to the different orders of connections.

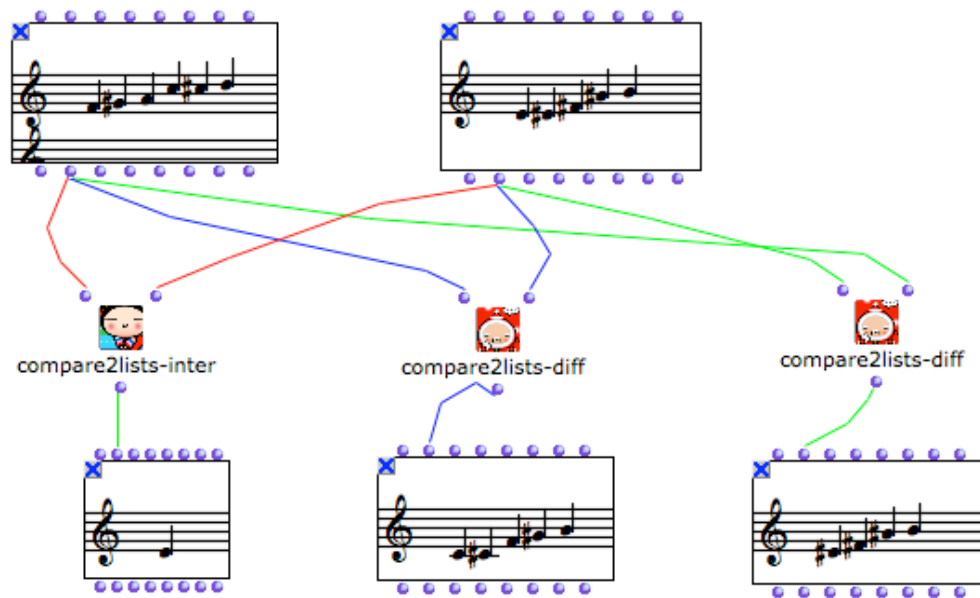


Figure 10

Objects *compare2lists-inter* and *compare2lists-diff*

- (7) The outer voices of a sequence of chords are usually considered important and the object *voice-leading*³³ is designed to separate them from the sequence in order to observe them closely.

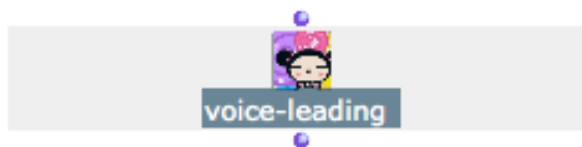


Figure 11 illustrates the function of this object, the result of which can be played in the chord-sequence editor. It is also capable to separate the voices inside a sequence of chords.

³³ This might not be a good name, which can be replaced by *melody-contour*.

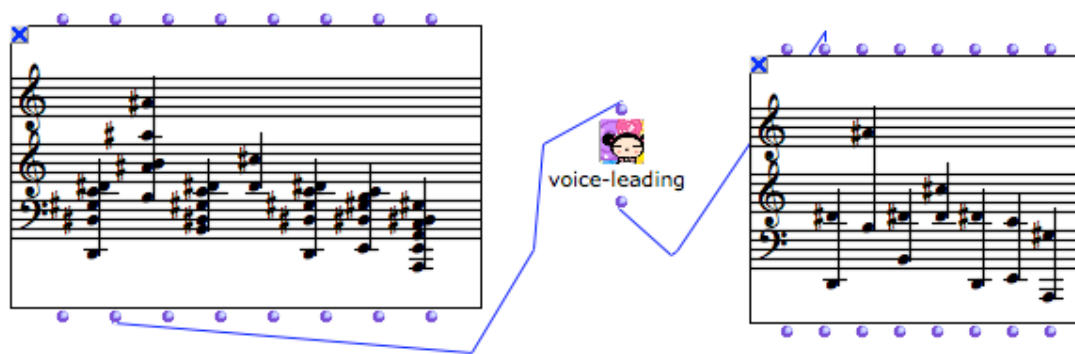


Figure 11
Object *voice-leading*

(8) The object *N-CERCLE* is a class object that belongs to the MathTool library. I have adopted this tool mainly for the purpose of graphical presentation of the pitch materials of the analysis. We can see that the round circle of the *N-CERCLE* object has been equally divided into 12, and each point is marked with a small empty circle. Note that it is possible to change the default divisions to 6, 24, 36, and so on. I define the two types of representation of the pitch materials: the first is to present the prime form of a given group of pitches while defining the 12 divisions as interval classes from 1 to 11. And second is to present the pitch class name of the given set while considering the 12 divisions as pitches from C to B (in most cases, it corresponds to the transposition of the prime form). Please refer to **Figure 12** below. There are four *N-CERCLES* in this example, of which the one on the far left is connected to the first outlet of object *getprime* and displays the prime form (0 1 2 3 4 5 6). The second from left *N-CERCLE* connects to the transposition of the prime form, which indicate the seven pitches employed (B C C# D D# E F). The third *N-CERCLE* represents the five missing pitches (marked letter B in blue), which are not included in the given melody (marked letter A in red). And the fourth *N-CERCLE*, on the right, displays the result of the whole twelve-tone scale while combining both sets of pitches together. Hence all twelve circles become red.

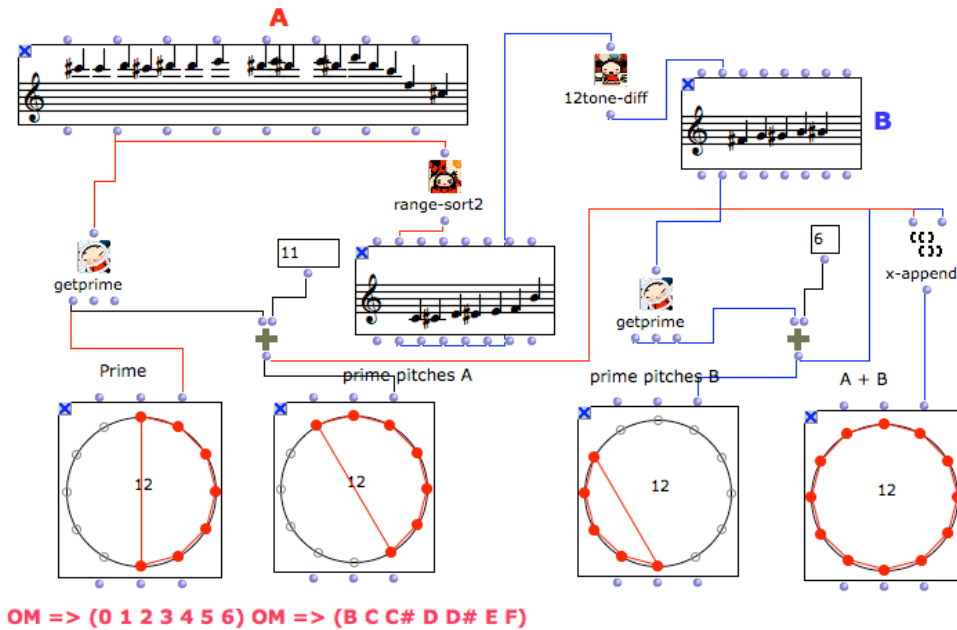


Figure 12
Illustration of graphic object *N-CERCLE* (1)

The object *N-CERCLE* is also useful for observing the structure of a chord sequence. In **Figure 13** shown below, I list three groups of chord sequences. The graphic presentations of the prime forms of these chords are very clear if we learn how to read them. The first two chord sequences are varieties that include chords composed of three to five notes. The lines in *N-CERCLE* drawn with different colors represent the prime form of each of the chords. If we compare the chord sequences marked A and B, we may conclude that B is more dissonant than A because they are very close to each other. Please keep in mind that the order of most consonant to most dissonant is interval 12 7 5 4 9 8 3 6 10 2 11 1, which can be interpreted to 0 5 4 3 6 2 1 if we convert all intervals within ic 1 to 6. Other than the tri-tone, larger interval classes are associated with more consonant chords.

The *N-CERCLE* in the middle of **Figure 13** indicates the narrow relationships of the chords that do not extend more than 6 and occupy the right half of the circle. On the contrary, the *N-CERCLE* of the chord sequence A on the left contains larger

interval relations that are more consonant. Chord sequence C is composed of six- to seven-note chords. Usually, the more pitches of a chord would make the chord more dissonant, but we can see from the graphic presentation that most of the intervals of the chords are not so close to each other (because it has reached 9 on the left side of the N-CERCLE). We may conclude by observing the N-CERCLES that the dissonant level of C is less than B but more than A. In order to prove my observation, I adopt an object *cognitive-sonance* of the SOAL library³⁴ to find out the average sonance levels of the three chord-sequences A, B, and C. The results correspond with the N-CERCLES, of which the sonance level of chord-sequence A is 0.47, 0.45, 0.34, 0.36, 0.45, 0.32, 0.41, 0.41, B is 0.88, 0.5, 0.88, 0.5, 0.88, 0.5, 0.46, 0.5, C is 0.52, 0.38, 0.5, 0.47, 0.3. Since the higher number means more dissonant, B is surely the winner of the most dissonant and C second and A last. In future analysis to come below, we should keep this information in mind especially, as it is useful for reading the graphical presentations in *N-CERCLE*.

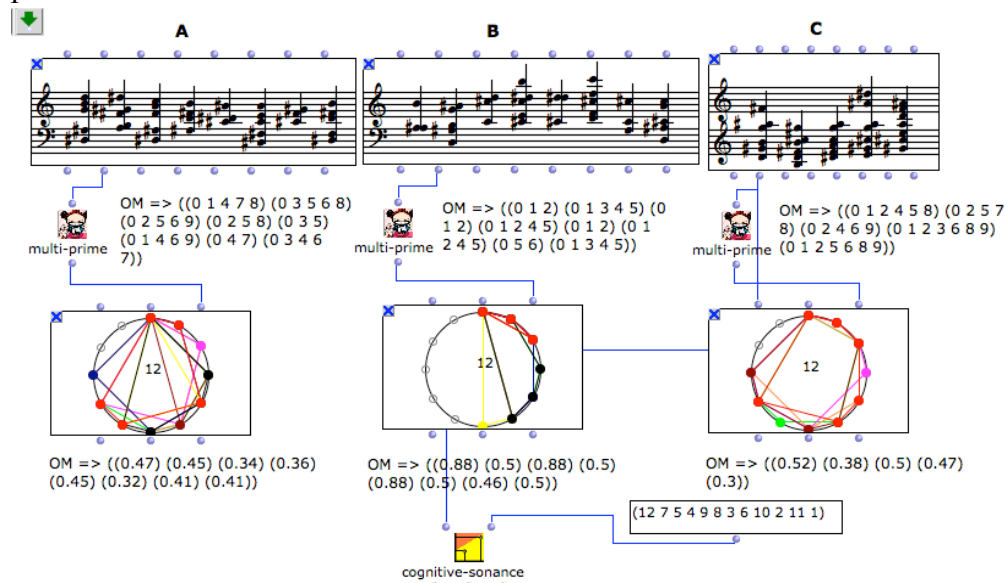


Figure 13
Illustration of graphic object *N-CERCLE* (2)

³⁴ SOAL (Sonic Object Analysis Library) is a library of tools for the OpenMusic environment, which is designed and developed by Didier Guigue and his team at Universidade Federal da Paraíba in Brasil.

(8) Another two useful class objects are *BPF* and *BPF-LIB* editors, which can display contours of melody and harmony. The melody in the chord-sequence editor on the left of **Figure 14** is graphically presented in the BPF editor below. The chord-sequence on the right is presented in the *BPF-LIB* editor, which displays the relative direction and ambitus of these chords.

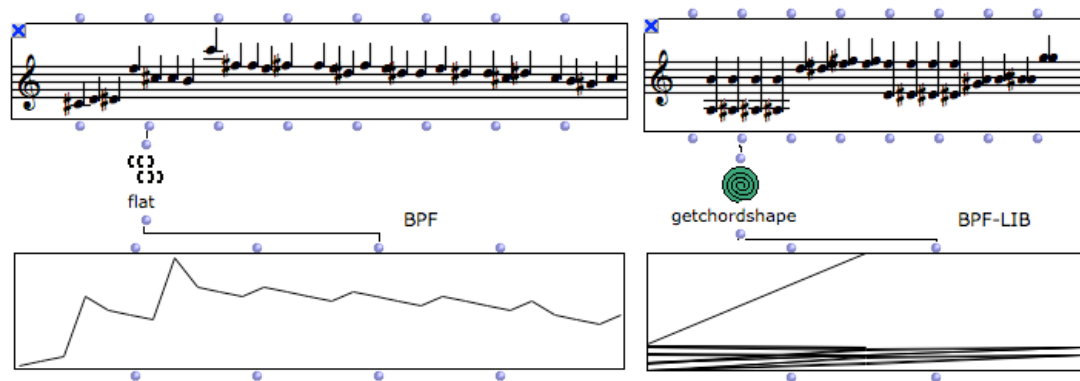


Figure 14
Illustration of graphic object *BPF* and *BPF-LIB*

Detailed Analysis of *Chain 2*

The First Movement *Ad Libitum*

The first movement can be described as introductory and fragmentary. As *Sheet Music* suggests, *Ad Libitum* associates with four types of interpretation of a given passage: “1. to play the passage in free time rather than in strict or “metronomic” tempo (a practice known as *rubato* when not expressly indicated by the composer); 2. to improvise a melodic line fitting the general structure prescribed by the passage's written notes or chords; 3. to omit an instrument part, such as a nonessential accompaniment, for the duration of the passage; or 4. in the phrase “repeat *ad libitum*,” to play the passage an arbitrary number of times (*cf.* vamp).” Though, only the first type is applied here. The first movement can be divided into four sections, a: beginning to rehearsal 5; b: rehearsal 6 to 11; c: rehearsal 12 to 14; d:

rehearsal 15 to 22. The solo violin has a leading role in the movement.

Six types of orchestral textures are employed in this movement. The first of these, orchestral pedal tones, are played by string pizzicatos at the very beginning, rehearsal 1 and 4, continued by chimes at rehearsal 7, vibraphone at rehearsal 8 and 9. (ex.16)



Example 16

Beginning of *Chain 2*, illustration of the pedal tone texture (Type 1)

The second type is the three-note bundle texture with limited aleatory technique, which is played on the woodwinds combined with the percussion instruments. Such texture can be found at rehearsal 1 and 4. (ex.17)



Example 17

Rehearsal 1 of *Chain 2*, illustration of the three-note bundle texture (Type 2)

The third type is slightly complex and includes repeated notes with aleatoric rhythms. It is mostly applied to the string section at rehearsals 2, 5, 7, 8, 9, 12, and on both the string and brass sections at rehearsal 13. (ex.18)

The musical score for Example 18, Rehearsal 13 of Chain 2, illustrates a repeated-note (Type 3) passage. The score is divided into two systems. The first system includes woodwinds (trb, trbni) and strings (vno solo, vni I div., vni II div., vle div., vc. div., cb. div.). The woodwinds play a fast single-direction passage, marked with 'poco f p'. The strings play a short chord, marked with 'f p'. The piano plays a sustained chord, marked with 'poco f p'. The second system includes woodwinds (trb, trbni) and strings (vno solo, vni I div., vni II div., vle div., vc. div., cb. div.). The woodwinds play a fast single-direction passage, marked with 'poco f p'. The strings play a short chord, marked with 'f p'. The piano plays a sustained chord, marked with 'poco f p'. The score is marked with 'poco f p' and 'f p' dynamics.

Example 18

Rehearsal 13 of *Chain 2*, illustration of the repeated-note (Type 3)

The fourth type is the fast single-direction passage played on the woodwinds, which combines with a short chord played on the brass instruments and the sustained chord played on piano. Examples can be found at rehearsal 3 and 6. (ex.19)



Example 19

Rehearsal 3 of *Chain 2*, illustration of the fast, single-direction (on each instrument) texture (Type 4)

The fifth and sixth types of textures appear only once in this movement, but they are further developed in the later movements. The fifth type is the sixteenth triplets either on a neighboring motion or moving upwards or downwards in smaller intervals such as minor and major seconds and thirds, and occasionally perfect fourth or larger.

Example 20

Rehearsal 10 of *Chain 2*, illustration of the fast-moving texture (Type 5)

The sixth type appears at the end of this movement from rehearsal 16 to 22, where strings are playing glissandos from one note to another, which creates beautiful sonorities.

Example 21

Rehearsal 16-7 of *Chain 2*, illustration of the slow-glissandi texture (Type 6)

As we begin to have some ideas about this movement, we may proceed to the next step, which is to analyze the movement in depth with the assistance and presentation of OpenMusic.

a. From the beginning to rehearsal 5

The violin begins from C4 playing tremolos on a major second between C4 and D4; then it quickly climbs up to C6. Please refer to **Figure 15**, which corresponds to the extracted score of example 22. The OM analysis indicates that the violin melody is composed with a symmetrical structure. Small intervals such as the minor second (ic 1) and major second (ic 2) are placed on the outside, larger intervals such as perfect fourth (ic 5) and tritone (ic 6) are placed in the middle. The OM object *rangesort2* aims to reduce a group of pitches to its minimum structure within an octave and meanwhile takes out repetitions of the pitches. The result indicates that there are six pitches employed in the solo melody, disregarding register, namely C, C#, D, F#, G

and B. Through the object *getprime*, we obtain the prime form (0 1 2 3 7 8), Forte number |6-Z38|, and interval vectors <4 2 1 2 4 2>. On the other hand, instruments of the orchestra such as the violins, violas, and cellos play only pizzicato on the note C4 at the very beginning of the movement simultaneously with the solo violin. This may be considered as the first pedal tone of the piece.

Example 22
Chain 2 before rehearsal 1

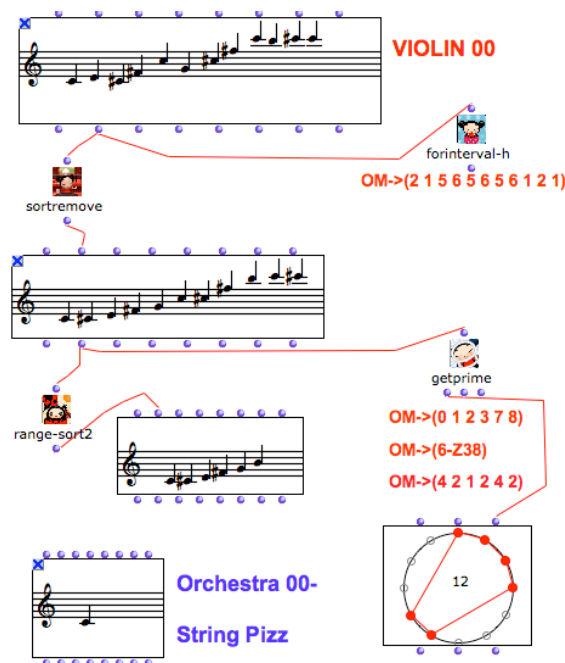


Figure 15
Illustration of the OM analysis before rehearsal 1

At rehearsal 1, the pedal tone moves from C4 to F#4 that is played pizzicato by violins and violas (the cellos do not play this time). In the meantime, the two flutes and chimes play the three-note sequence F#4-G#4-G4. The solo violin continues, climbing by minor seconds from Db6-D6-Eb6-E6 until F6. It then quickly moves down to F5 through minor thirds (ic 3) and perfect fifth (ic 5). Please refer to **Figure 16** below, where I include new objects such as *12tone-diff* and *12tone-diff2* for the OM analysis. Object *12tone-diff* calculates to find those pitches of the aggregate that are not included in the given list of pitches within a twelve-tone scale (i.e., the complement). For instance, when the twelve-tone scale from B4 to A#5 is set to be the range as shown in **Figure 16**, we obtain the complementary set of pitches F#, G, G#, A, and A# after evaluation. As the flutes and chime jointly play on the ad lib. passage that is composed of three pitches, F#, G and G#, the object *12tone-diff2* compares the two lists of pitches, and then calculates the pitches obtained in the first list but missing in the second list. The result returns A and A#, which indicates that there are ten pitches employed between the solo violin and orchestra.

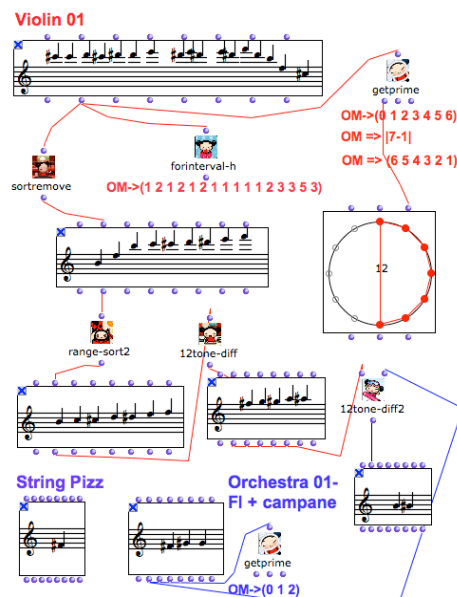


Figure 16
OM analysis of rehearsal 1

All the strings play the first sustained chord composed of pitches A2-D3-F#3-Bb3 after the staccato repetition of the same chord, which begins at rehearsal 2. The OM analysis quickly calculates the prime form of the chord as (0 3 4 8). There are two passages of the solo violin melody that are separated by a fermata sign. The first begins from F5, then climbs gradually to Db6 by going back and forth through tritones (ic 6), minor seconds (ic 2), and a perfect fifth and fourth (ic 5). It then goes down through thirds and seconds. Note that the melodic line here seems to obey a rule: minor second or minor third is employed when the melody is moving downwards; major second and major third are employed when the melody is moving upwards. The second passage begins on B3 and then climbs up to F5 through minor seconds and minor thirds. After F5, the melody goes down and up again, this time to an even higher register and reaches E6, passing through intervals such as the minor sixth (ic 4) in addition to minor seconds and minor thirds. Finally it reaches the high note, F6, through a minor third, perfect fourth, and minor second.

Figure 17 illustrates the pitch materials and OM analysis of rehearsal 2. We find the joined pitch field of both melodic passages on the right-hand side, which indicates that 1 and 3 are the primary interval classes in this passage (ic 2 appears in the middle). The analysis once again indicates the symmetrical feature of the pitch organization. In comparison with the four pitches that form the sustained chord, these two sets of pitches do not share pitches. Object *12tone-diff2* combines both sets of pitches of the solo violin and orchestra and calculates that the only pitch missing from rehearsal 2 is G.

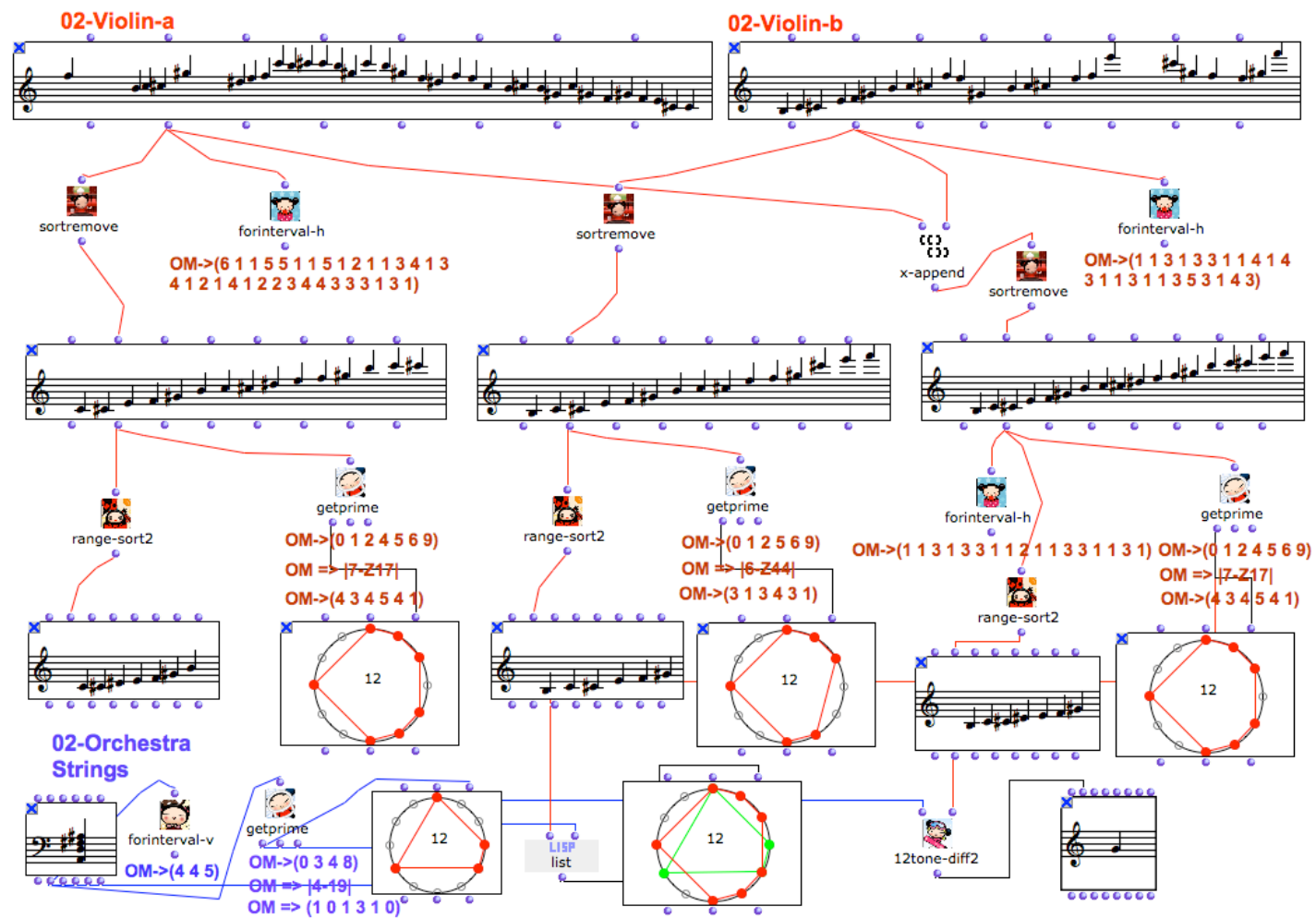


Figure 17
OM analysis of rehearsal 2

New elements appear at rehearsal 3, where clarinets and bassoons play either downward or upward melodies that consist of only interval classes 1 and 3. On the other hand, the piano takes over the sustained chord previously played by the strings with a new chord composed of pitches Bb2-E3-A3-C#4 (prime 0 1 4 7). The solo violin continues from F6 and reaches a high point on note Ab6. **Figure 18** below indicates that interval classes 1, 5, and 3 are the main intervals of the melodic line, while interval classes 2 and 4 each appear once. Note that the piano plus solo violin add up to eleven pitches, excluding D.

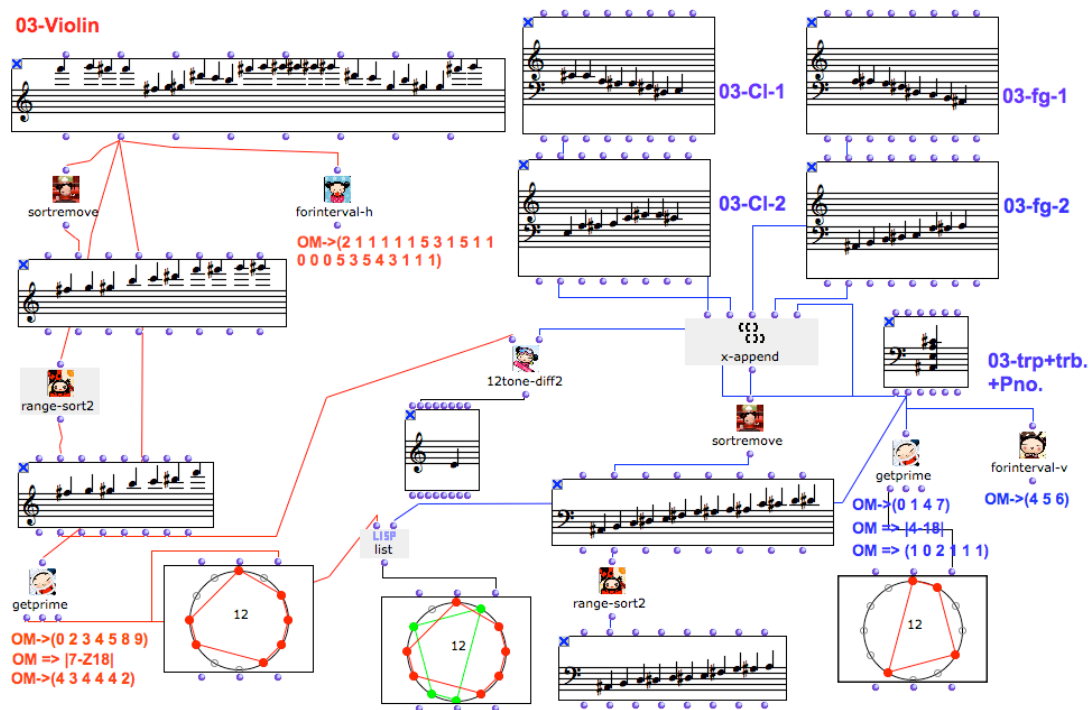


Figure 18
OM analysis of rehearsal 3

At rehearsal 4, one finds that the materials are recapitulations of the elements of rehearsal 1: instead of the set of pitches F#4-G#4-G4 played on the flute and chimes, bassoon, and marimba play a similar sequence of F3-G3-Gb3 in a lower register. The pizzicato element at rehearsal 1 reappears here at the beginning of

The melody of the solo violin is composed of five pitches, C, D#, E, A#, and B. As shown below in **Figure 20**, if we combine the pitches of both the solo violin and orchestra, we have three pitches, D, F#, and G, are missing from the aggregate. What is quite interesting is that the three missing pitches happen to be the pedal tone F# of rehearsal 1 and the missing pitches G and D of rehearsal 2 and 3. This discovery implies an inner relationship in the pitch organization, which Lutosławski may have carefully planned.

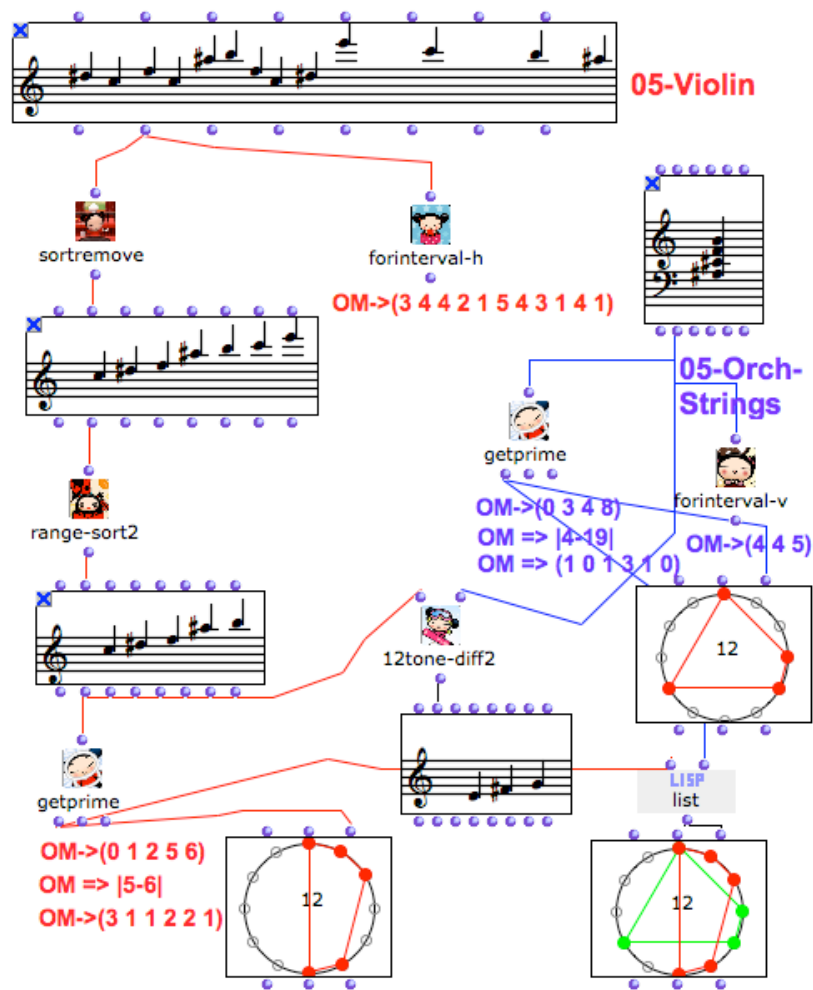


Figure 20
OM analysis of rehearsal 5

b. From rehearsal 6 to 11

At rehearsal 6, similar elements to rehearsal 3 have returned. But instead of clarinets and bassoons, a new group composed of flutes and clarinets plays the vivid passages. The four-note chord played on the piano is transposed up by exactly a major seventh, compared to the four-note chord at rehearsal 3. The new elements begin on the solo violin, which contain natural harmonics of a melody composed of five pitches, A#, B, D, F#, and G. Through the analysis shown in **Figure 21** below, we find that three pitches, C#, E, and F, are missing in this passage.

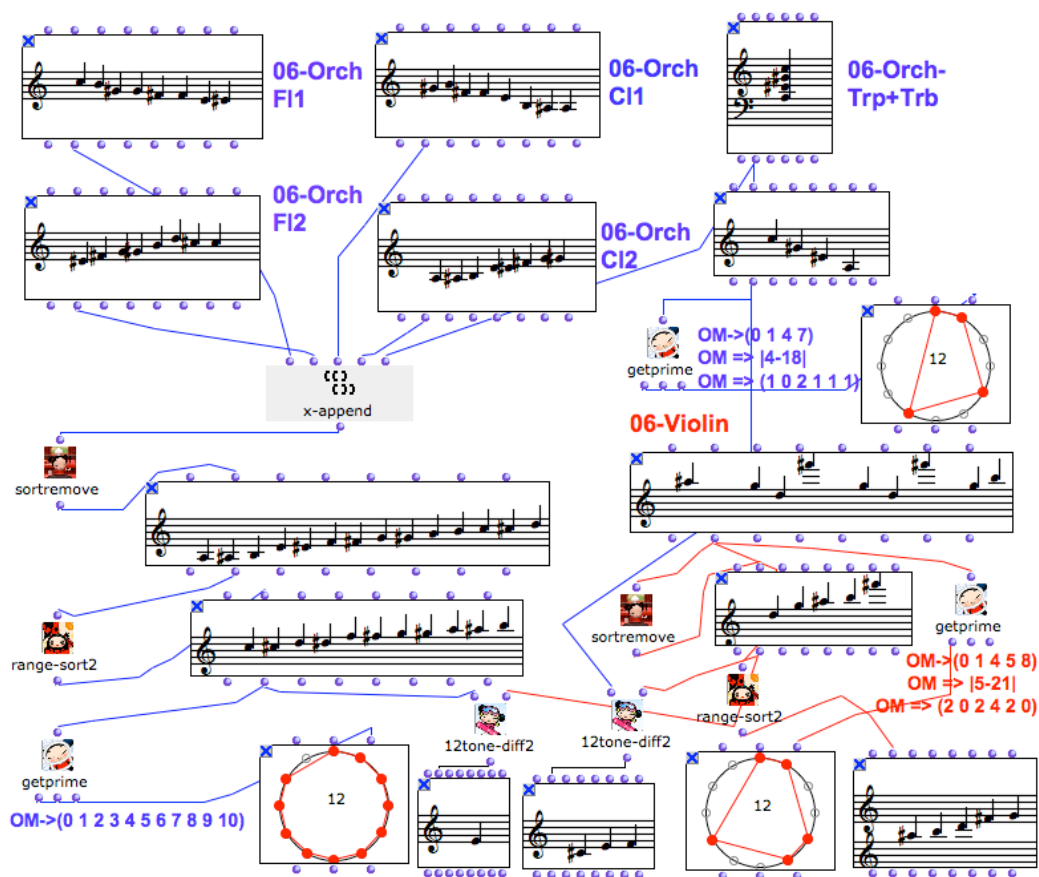


Figure 21
OM analysis of rehearsal 6

At rehearsal 7, the glockenspiel and violins join to play the note F7, in a

texture and instrumental reminiscent of rehearsal 1. But instead of a three-note sequence, a single pitch is repeated, a transformation of the pedal tone in a higher register. Through the analysis indicated in **Figure 22** below, we find that the latter part of the solo violin melody follows a rule, which is that only the interval pairing of ic 1 and 3 can be used. And once again, we use the OM tools to find out what pitches are missing and the result returns the pitch C. It seems that a group of eleven pitches are employed in significant sections that are separated by rehearsal numbers.³⁵

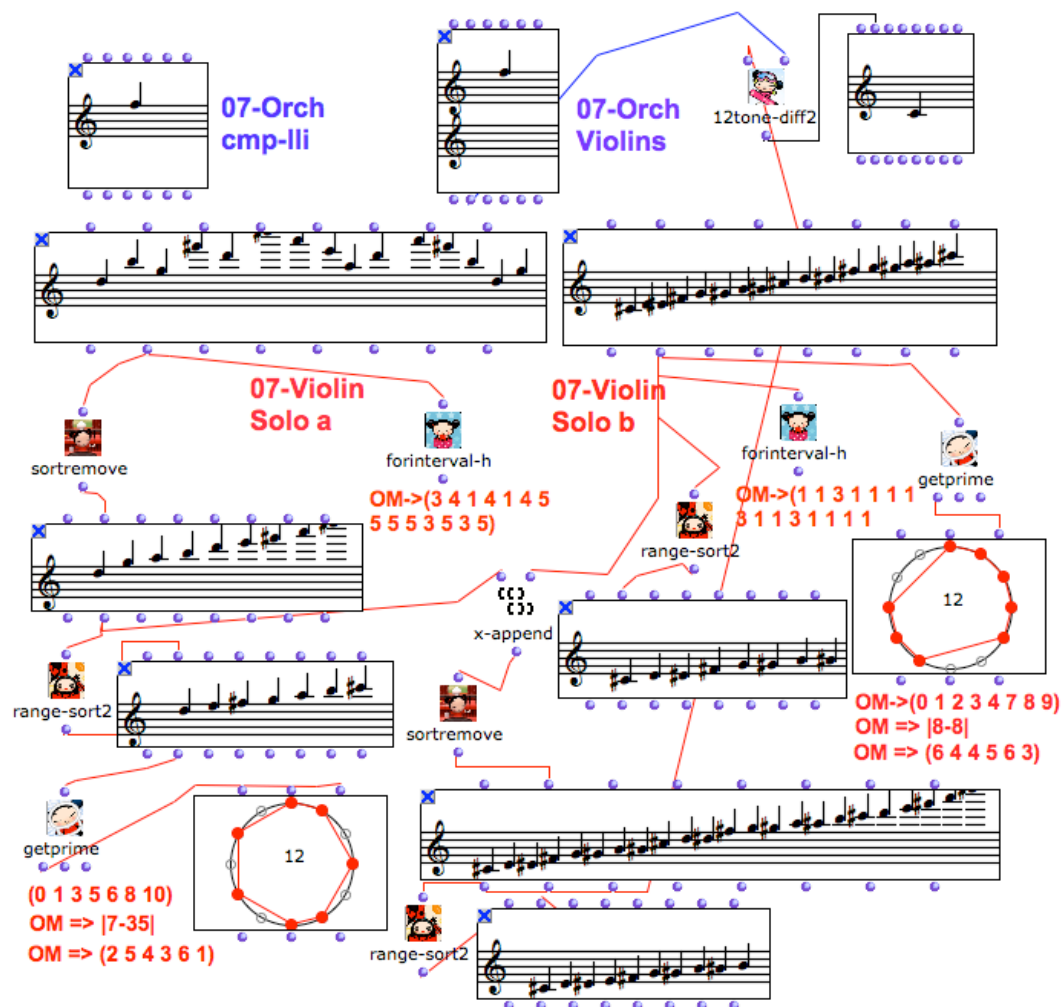


Figure 22
OM analysis of rehearsal 7

³⁵ As I have indicated in earlier chapters, passages separated by rehearsal numbers are considered important for the analysis of the pitch organization and structure of Lutoslawski's works.

Similar passages continue at rehearsal 8, but the combination of glockenspiel and violins is replaced by vibraphone and lower strings (violas and violoncellos), which join together to play the note Bb3. Later, a single clarinet and bassoon take over and play the vivid passages composed of the minor second Bb3- Cb3. **Figure 23** below indicates to us that an upward major second (ic 2) breaks the interval pairing of 1+3. Two pitches, D# and E, are missing from the whole section.

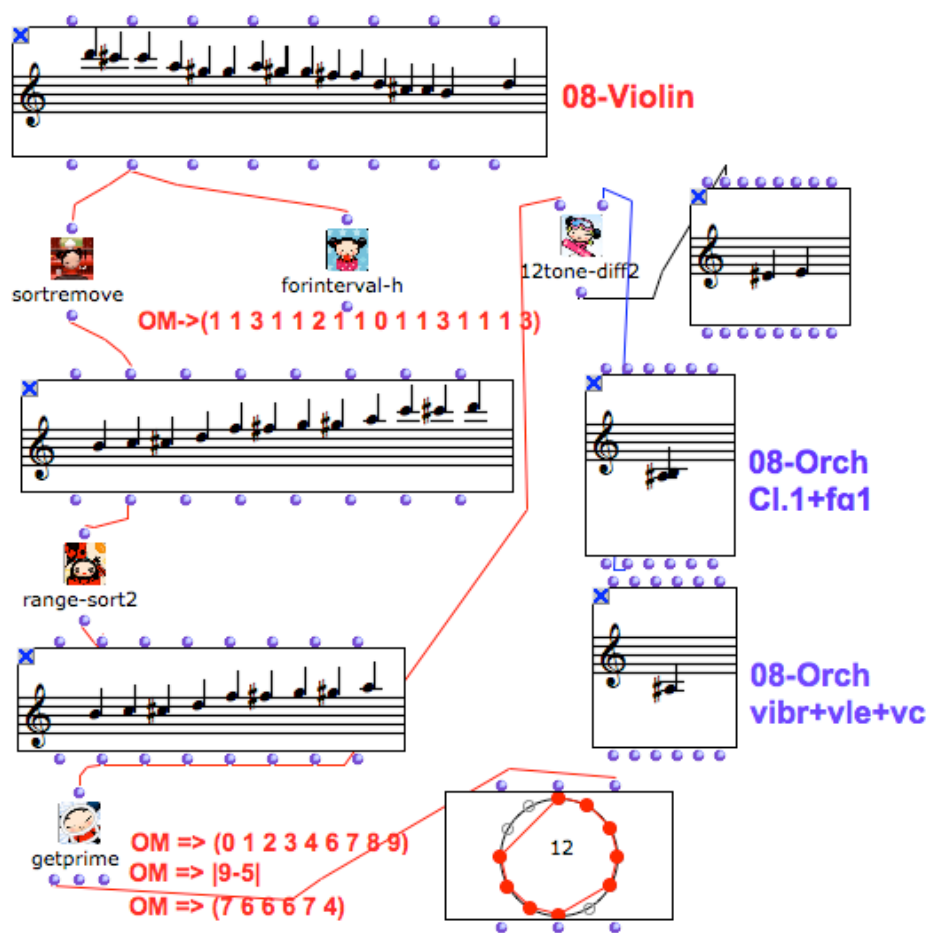


Figure 23
OM analysis of rehearsal 8

The music of rehearsal 9 contains probably the fewest pitch materials of the movement. The pitch moves from Bb3 to B3, while the solo violin plays a passage

composed of two major sixths, G4-E5 and G#4-F5. (Figure 24)

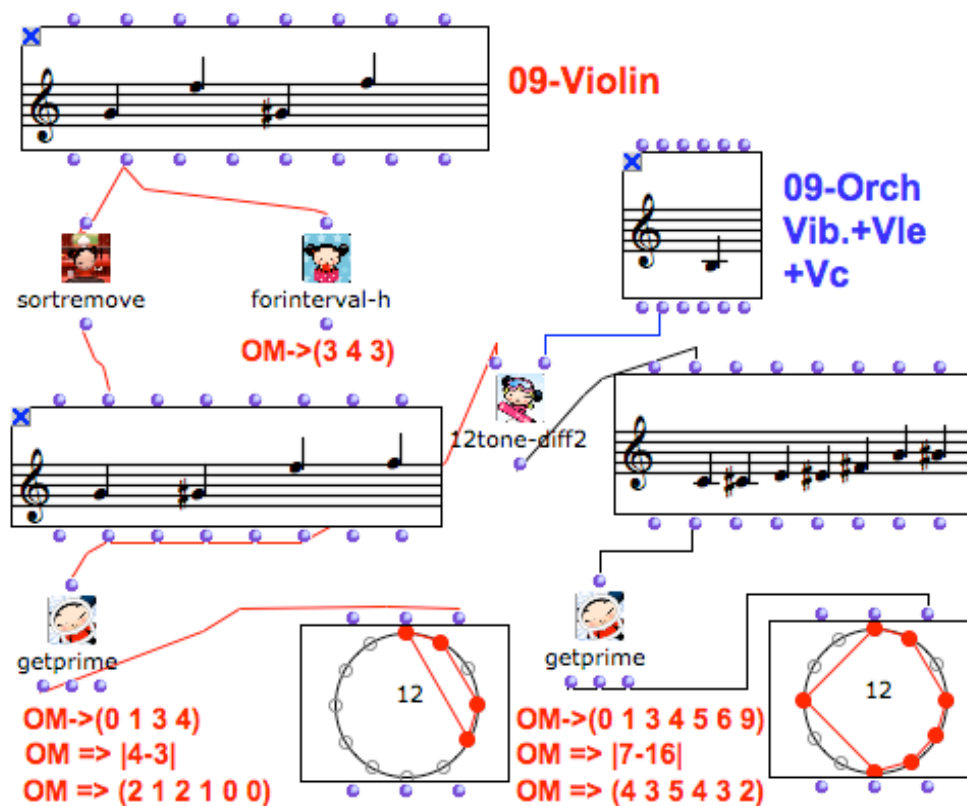


Figure 24
OM analysis of rehearsal 9

The solo violin melody continues from rehearsal 9 to rehearsal 10, where all woodwinds play vivid passages composed of three types of interval classes 1, 2 and 3. And the pitch materials are chosen from eleven pitches, excluding A. Since the pitch A has appeared in the previous passages on the solo violin, we find that all twelve pitches are employed in this section, marking this section as the most complex of the movement. Note that the red patches on the left side of **Figure 25** contain detailed analysis of the materials of each instrumental part, which are not displayed due to the space limitations below.

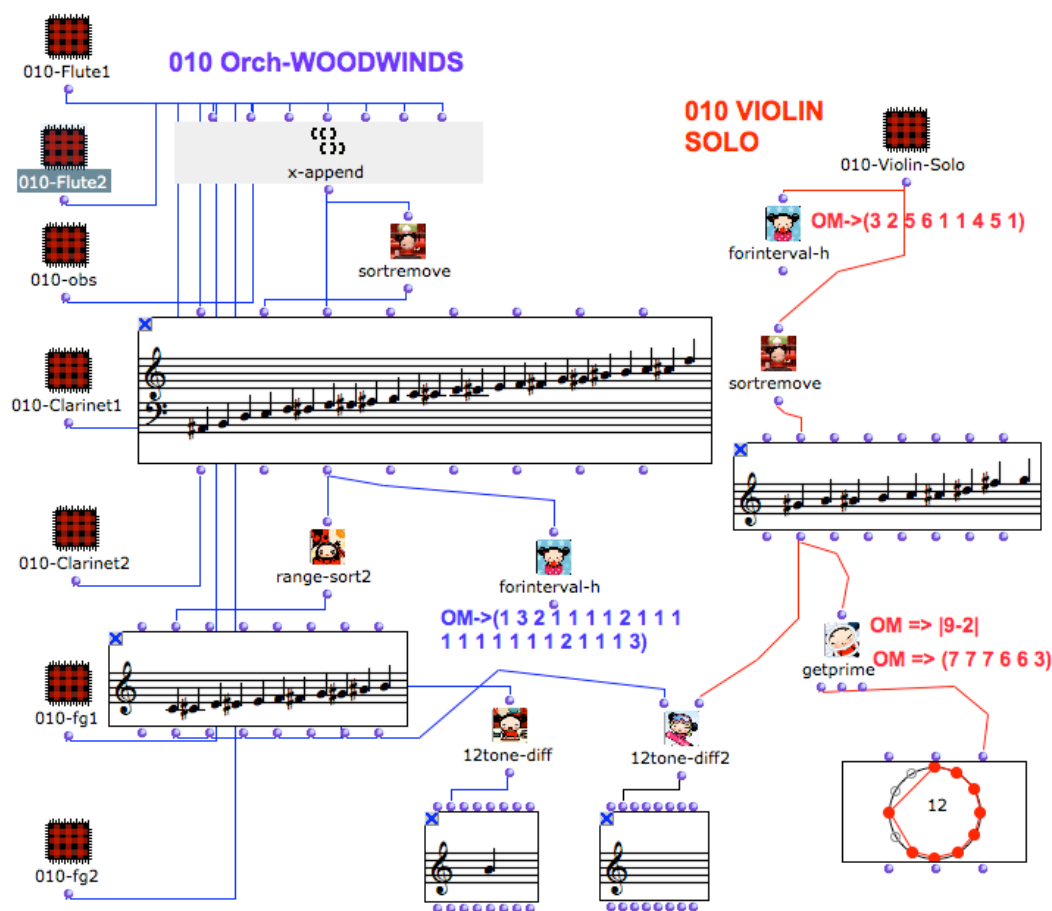


Figure 25
OM analysis of rehearsal 10

At rehearsal 11, the strings take over the lead role from the woodwinds and play two four-note chords, which remind us of similar chords in the previous rehearsal numbers. If we look at the analysis shown in **Figure 26**, we find that the prime forms of these chords are (0 1 4 8) and (0 1 5 8). The first chord is composed of ic 3 and 4, and the second chord is composed of ic 4 and 5. We may now analyze the melody of the solo violin, with the results shown in **Figure 26**. The first part of the melody consists mostly of a pair of interval classes, 4 and 5; the second part contains another pair ic 1 and 3. Through the object *12tone-diff2*, we find that there are ten pitches employed in this passage, excluding only E and G. A new object, *compare2lists-inter*,

is introduced here and compares two sets of pitches and calculates the pitches shared in both sets. In this case, we obtain the result of pitch D, the only note shared between soloist and orchestra.

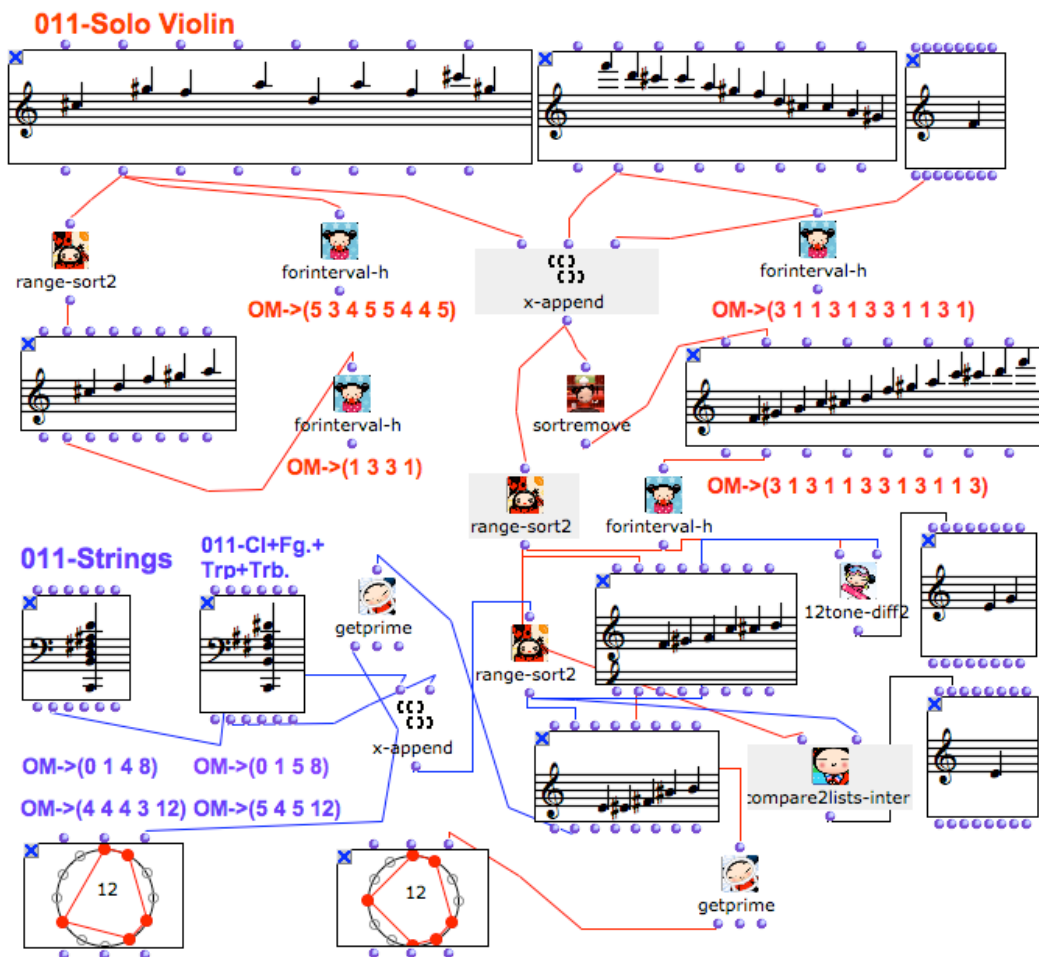


Figure 26
OM analysis of rehearsal 11

c. From rehearsal 12 to 14

The texture of the strings remains, but the harmony changes with a new four-note chord at rehearsal 12. The top voice played by the violins keeps moving by minor seconds. By contrast, the solo violin begins a new phrase with more lyrical voices instead of fast passages. The analysis shown in **Figure 27** below indicates that the ic pair 1 and 4 is emphasized. The seven pitches employed in the passage do not share

the six pitches employed in the orchestra except D. Note that we should not confuse this with the pitch materials in rehearsal 11, where ten pitches are employed. There are eleven pitches employed in rehearsal 12, counting both the pitches of the solo violin and orchestra. Only the pitch B does not appear in this section.

012-Violin Solo

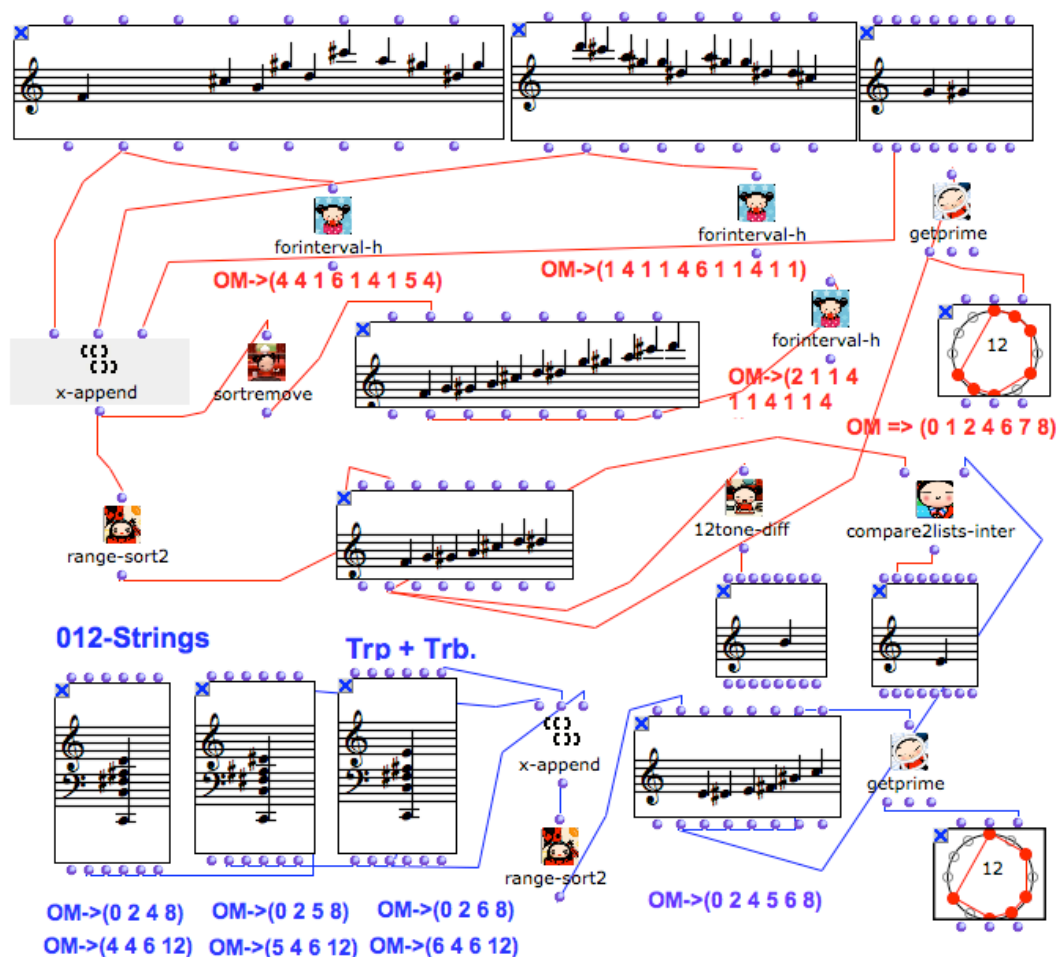


Figure 27
OM analysis of rehearsal 12

The music of rehearsal 13 is the continuation of rehearsal 12, where trumpets and trombones repeat and move by steps irregularly the pitches assigned to them. In **Figure 28**, we find that they share the pitches of the strings, which are the slowly moving type of four-note chords. The melodic line of the solo violin is composed of

two types of materials: at first, the melody is moving downward, emphasizing a pair of interval classes, 1 and 3, followed by ic 3 and 4; the second part of the melody introduces a brand-new element, which is two-note chords linked to one of the key materials of the second movement. We can see from the analysis shown in **Figure 28** that the pitch organization of this section is nearly symmetrical, with a pair of interval classes, 1 and 2, on the outside and ic 3 in the middle. All twelve pitches are employed in this section, as we observe the result of *12tone-diff2*.

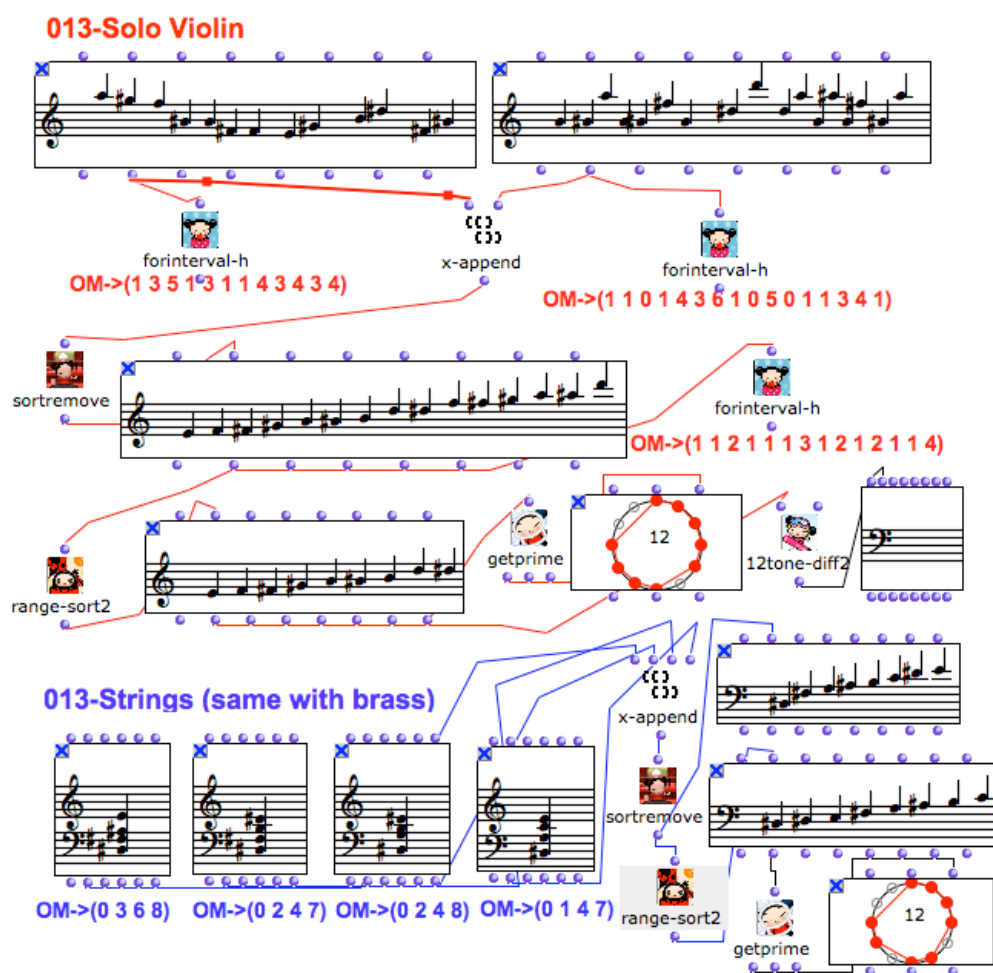


Figure 28
OM analysis of rehearsal 13

At rehearsal 14, while the solo violin continues to play the two-note chords, a perfect fifth in artificial harmonics recurs, which intersects with the two-note chords.

At first, the orchestra accompanies the solo violin with short *tutti* chords that consist of five notes. Then at the very end of this section, flutes and clarinets play a vivid passage composed of a three-note pattern that finally reaches a very high register. Please refer to the analysis shown in **Figure 29**, where we find that the pitch organization of the melody implies an interval pairing of 1+3. Moreover, the analysis of the sequence of five-note chords in the orchestra implies another pair of intervals, 1+2. In addition, the vivid passage played on woodwinds at the end implies another pair, 1+4. Note that eleven pitches are once again employed in this section, excluding only the pitch D. This reminds us of the similar arrangement of pitch materials in previous sections.

d. From figure 15 to 22

After the fortissimo chord played on the piano at the beginning of rehearsal 15, strings play a sustained four-note chord, which shares the pitches of the piano chord. The solo violin plays a *sostenuto* melodic line, which moves by large leaps and finally reaches the high note F7 at the end of this section. With the OM analysis shown in **Figure 30** below, we find that the interval pairing of 2+5 is employed here, with one exception of an ic 4 appearing in the later part of this phrase. The four-note chord played on the strings is symmetrical. As there is no result shown after the evaluation of object *12tone-diff2*, it implies that all twelve pitches have been employed. We then use object *compare2lists-inter* to find out whether the two lists of pitches (solo violin and orchestra) share any pitches. The result indicates that the pitch A# overlaps between the two lists. With the exception of the overlapping A#, the pitch materials of the solo violin and orchestra are almost complementary.

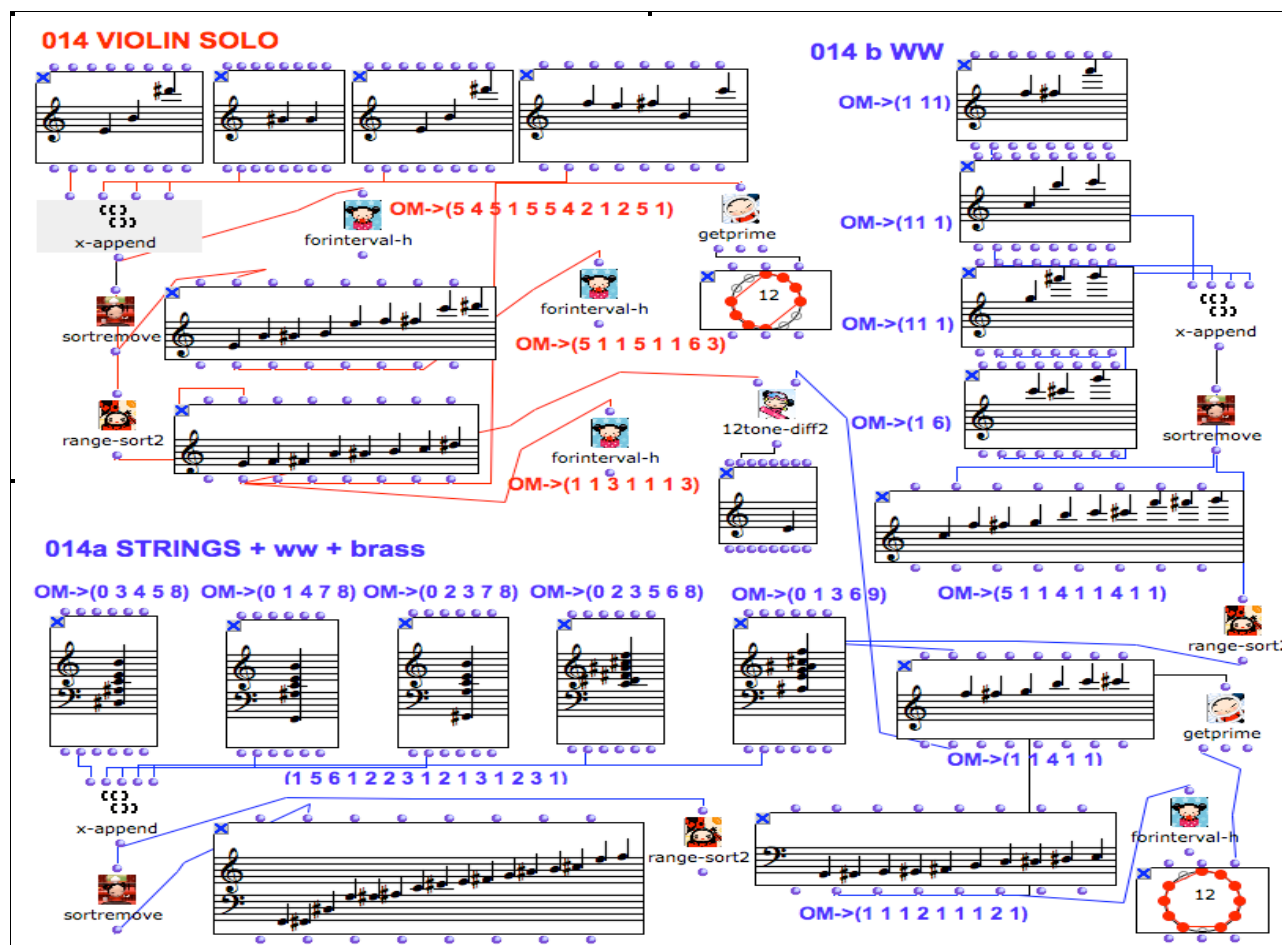


Figure 29
OM analysis of rehearsal 14

Furthermore, we find that the sustained chords in the strings are two four-note chords, each symmetrically composed. Both of the outer voices of these chords are a perfect fourth apart. The relationship between the pitches of the solo violin and the strings is that the two lists share C and C#. All twelve pitches are employed in this section.

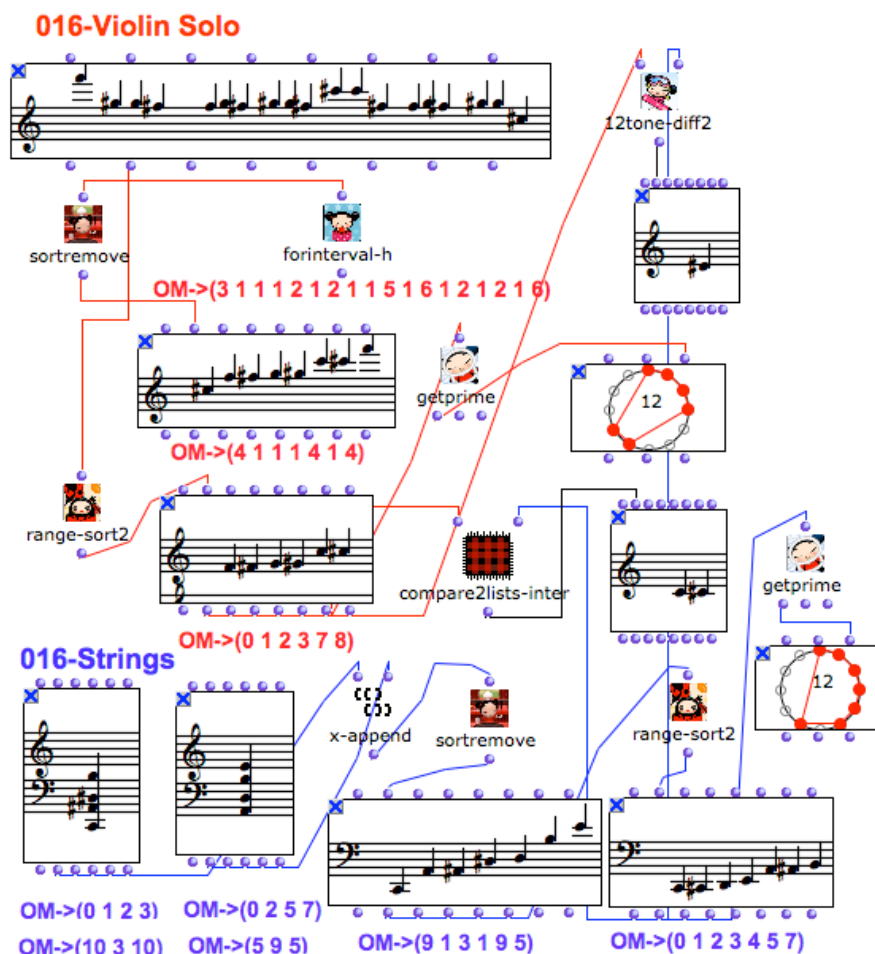


Figure 31
OM analysis of rehearsal 16

From rehearsal 17 to 18, we find two symmetrical chords that move from one position to the other. As shown in **Figure 32**, that the melody of the solo violin emphasizes a pair of interval classes, 1 and 2, followed by ic 5 and 6. The pitch structure, however, implies an emphasis on ic 1 and 4. Since the OM analysis indicates that the pitch B is not employed either in the solo melody or in the strings, we

conclude that a set of eleven pitches is employed in this section, as well as that two pitches, G# and A, are shared by both lists.

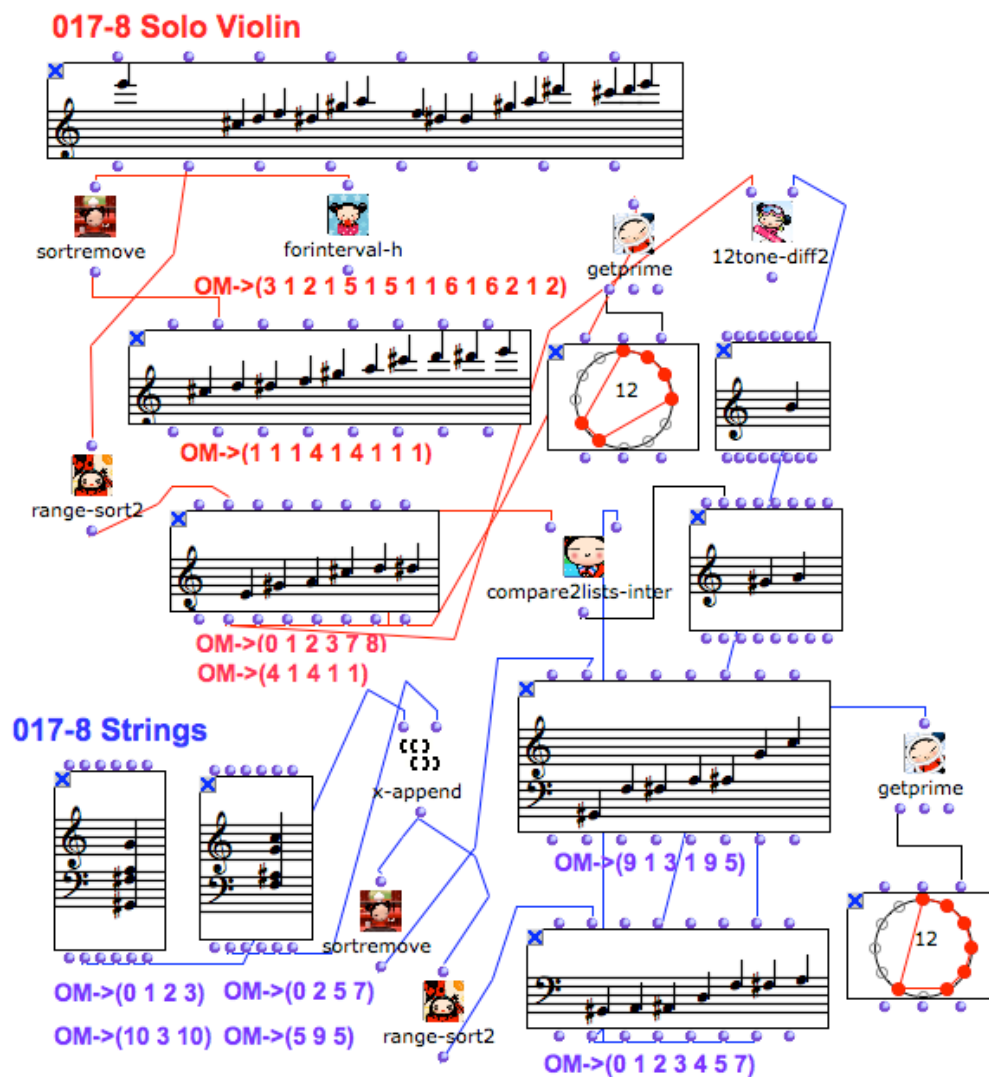


Figure 32

OM analysis of rehearsal 17-18

From rehearsal 19 to 22, the solo violin continually plays a sequence composed of three-note patterns that contain only two types of intervals: minor and major seconds. On the other hand, strings continue to play a group of four-note chords climbing from G#5 to C#6 in the top voice and A3 to F#5 in the lower voice. Through the OM analysis shown in **Figure 33**, we find that only the pitch C is missing, and that

both lists of pitches share the pitch F.

019-22 Violin Solo

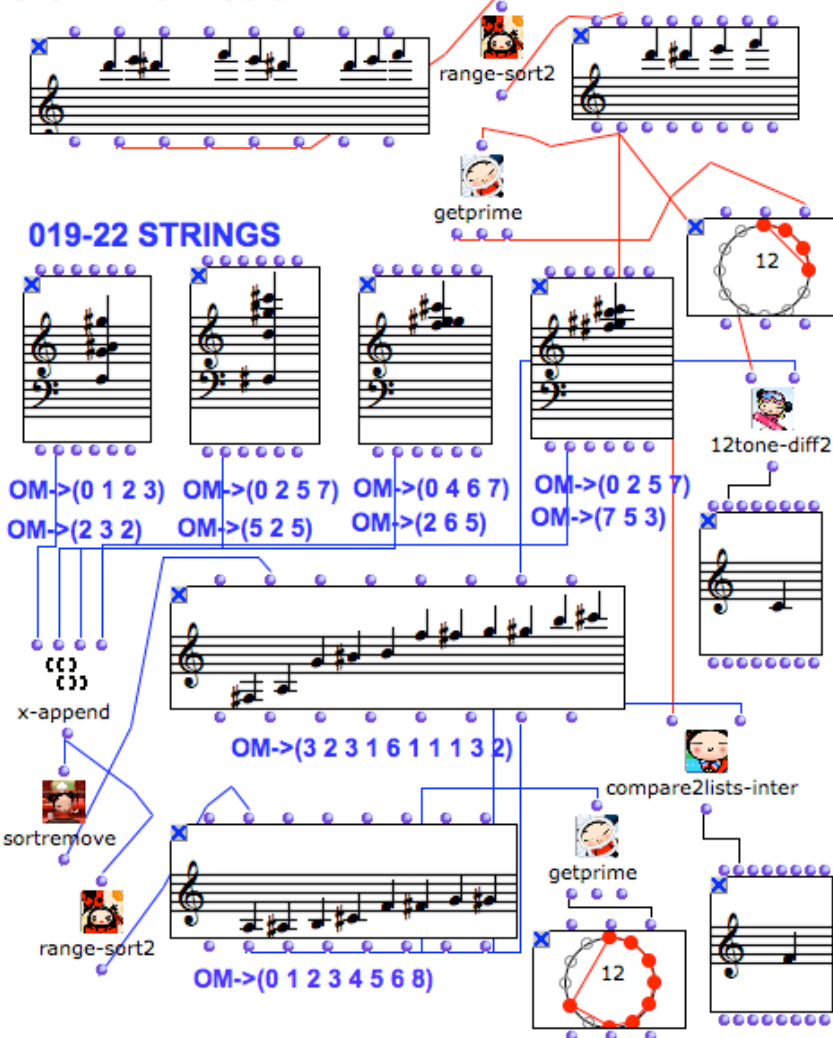


Figure 33
OM analysis of rehearsal 19-22

We may now review the first movement with the assistance of some new OM patches. As I have indicated in earlier chapters, the graphic interface of OM and the convenience of manipulating materials are advantages of this analytical method. In the analysis shown until this point, we have focused on the materials of the rehearsals in order. In the next figures, I divide the material by their features, for instance an overview of pitch organization (**Figure 34**), graphical presentation of the pitch and

structure (**Figure 35**), and the melodic contours of the solo violin line (**Figure 36**).

The OM analysis shown in **Figure 34** includes two adjoining steps: First, all the outlets are connected in order to send pitch-class information of the pitch classes of each section (defined by rehearsal numbers) are separated into two parts, solo violin and orchestra. Then I use the green patch (an OMloop editor) named *Multi-Prime* to obtain the prime form of each set employed in the sections. After evaluation, we can see the results of both the solo violin and orchestra. During the next step of analysis, I compare the pitch materials of the solo violin and orchestra of each rehearsal in order to find out how many pitches of the aggregate are employed. With a green patch *Differ4*, we obtain the results in the third chord-sequence editor.

We have indicated repeatedly that an interesting feature of this movement is the appearance of pedal tones. This concept not only includes actual pedal tones at places like rehearsals 1, 4, 7, 8 and 9, where single pitches are emphasized by a number of instruments, but also, we discover, the frequent use of eleven-pitch sets throughout the movement which implies the importance of the missing pitch because it creates the expectation of hearing these missing pitches in the following passages. One excellent example can be observed relatively easily in **Figure 35** below, where we observe that the note C is emphasized at the very beginning of the movement but is the only pitch missing at the end of the movement (please refer to the graph shown in the *N-CERCLE* on the bottom of the last section of this Figure).

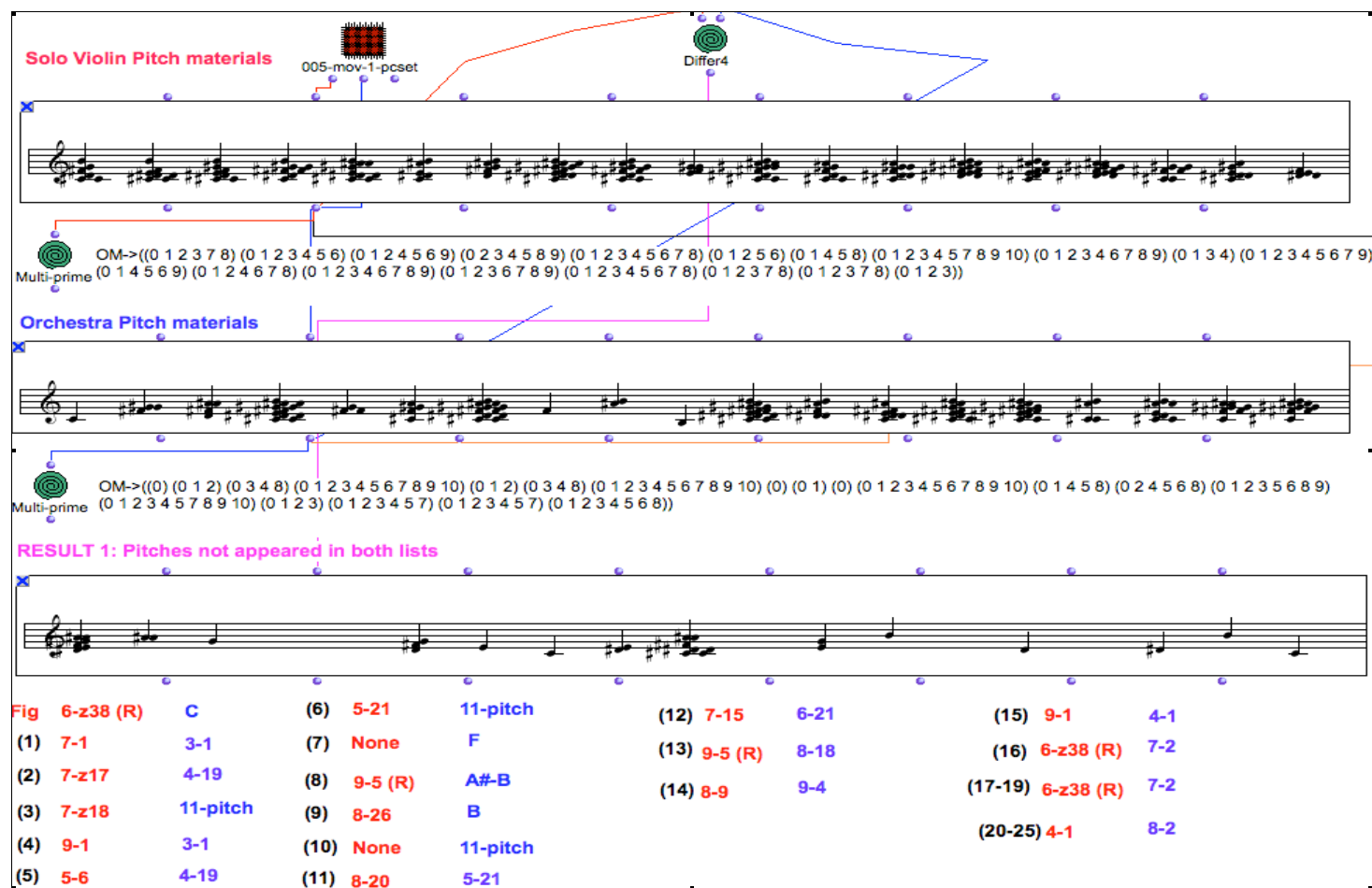


Figure 34

An overview of the pitch organization of the first movement: 1. Pcset

I would now like to explain more fully the graphical presentation of the movement, illustrated in **Figure 35**. In this graph, we can see six layers vertically, of which the first (top) layer represents the sound files of each rehearsal number; the second (from the top) layer represents the pitch materials of the solo violin line. Note that we have mentioned two types of pitch representations with the *N-CERCLE* object. In contrast to the *N-CERCLES* adopted in the figures of individual OM analysis, the graphical presentations of the pitch materials shown here represent the second type,³⁶ which indicates the pitches (from C to B) and may be understood as the transpositions of the prime forms. The third and fourth layers are the melodic contours of the solo violin. The fifth layer corresponds to the pitch materials of the orchestra. And the sixth layer represents the pitch materials of each of the individual sections, combining both solo violin and orchestra. In each of these boxes contained no matter what elements, sound, *N-CERCEL*, or *BPF*, is all sized according to the duration time of each section (defined by rehearsal numbers). We can also review the time structure besides the pitch organization. It is clear that Lutosławski has carefully planned the density of the pitch materials, which smoothes the music as well as creates contrasts.

Figure 36 indicates the melodic contours of the solo violin line, separated from **Figure 35**. In the *maquette* editor, we can hear the sound files while viewing the melodic contours, which helps us hear the piece on a deeper level. Such an experience cannot be offered with traditional analytical methods.

³⁶ Please refer to page 47, where I explain the two types of presentation with the *N-CERCLES* object.

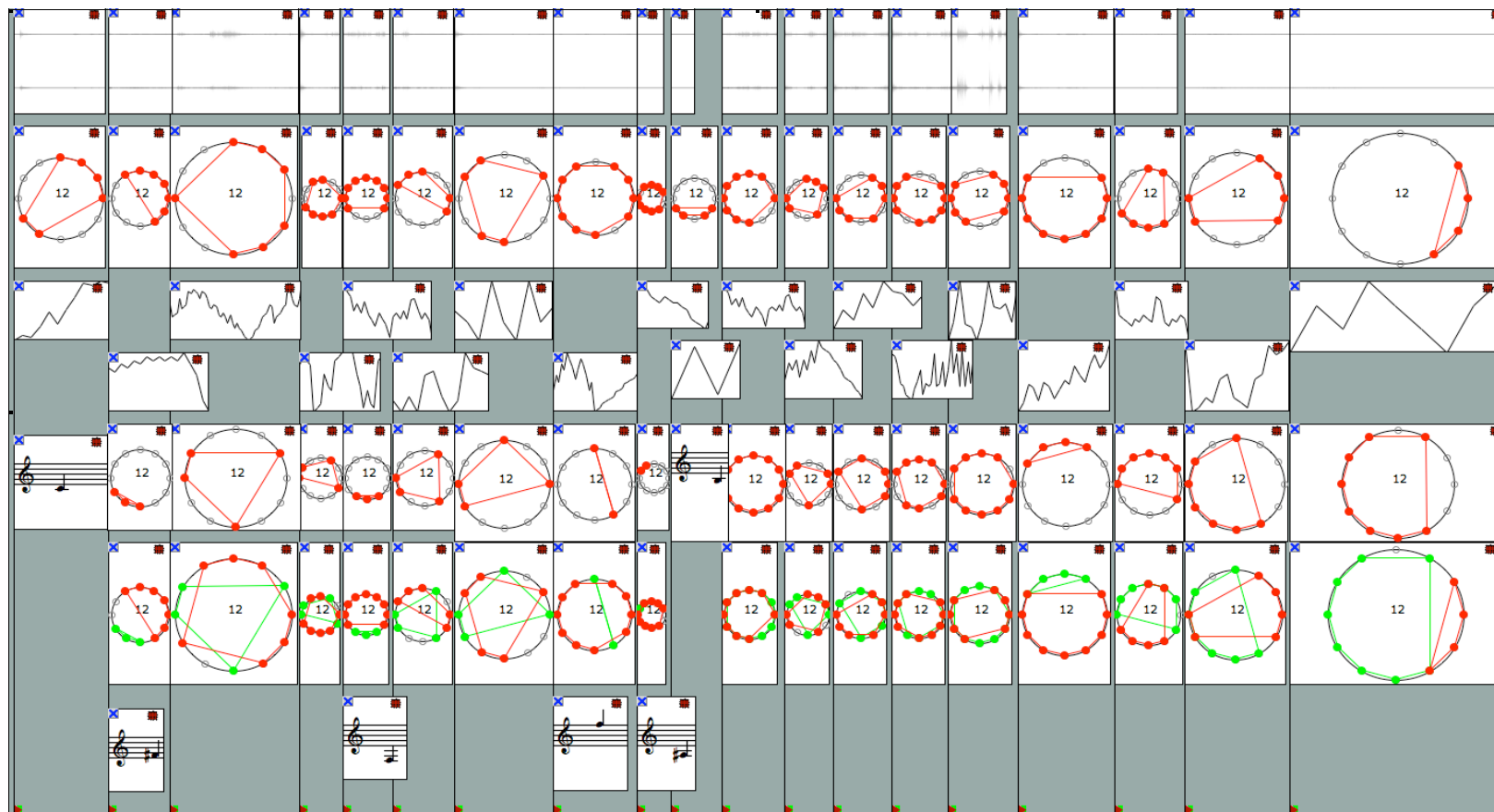


Figure 35

An overview of the pitch organization of the first movement: graphic presentation

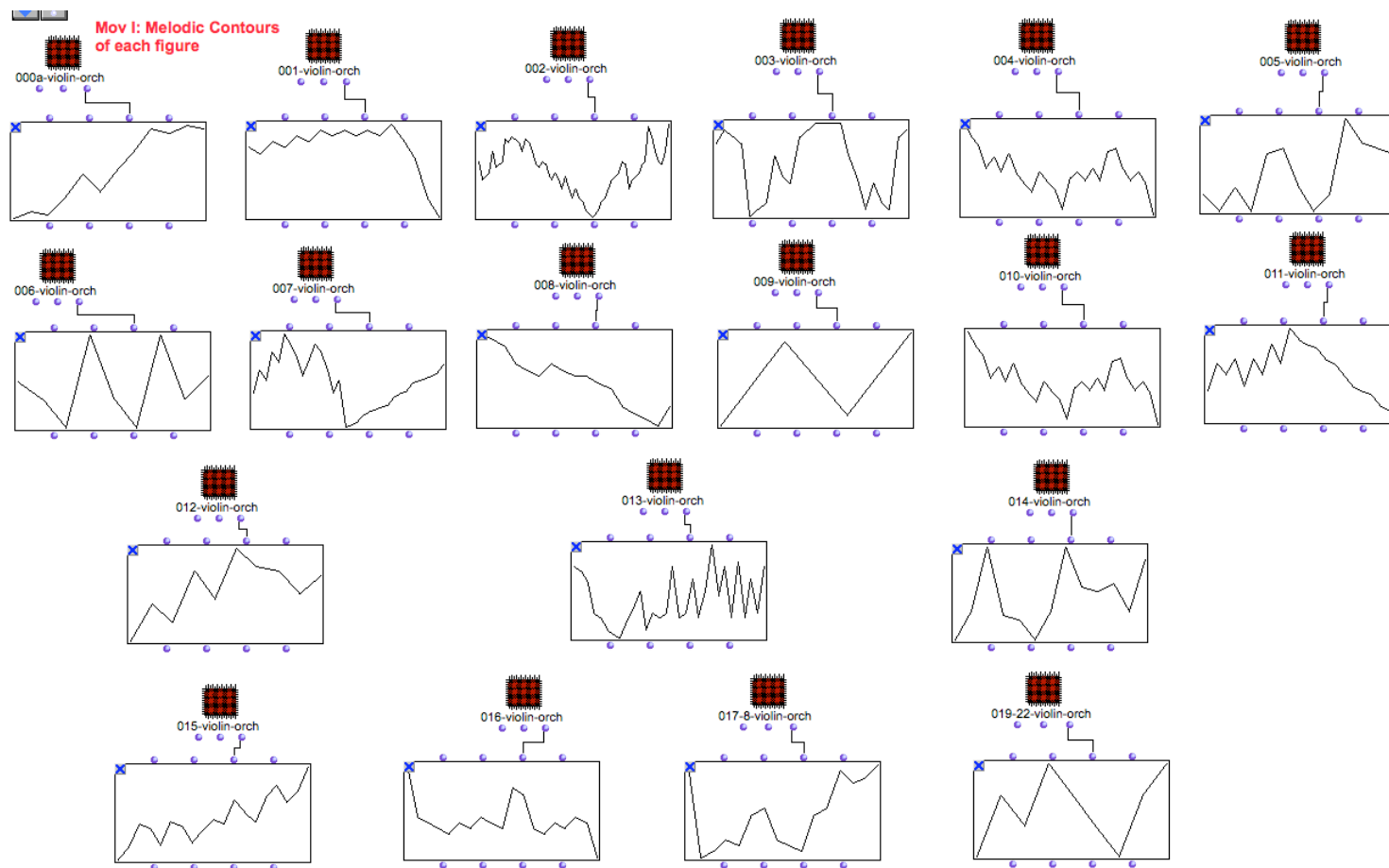


Figure 36
Melodic contours of the solo violin in movement I

The Second Movement *A Battuta*

We have not yet discovered the key feature of this piece, which is the chain technique. On the contrary, the second movement is structured with chain-form:

In a work composed in chain-form, the music is divided into two strands. Particular sections do not begin at the same moment in each strand, nor do they end together. In other words, in a middle of a section in one strand a new section begins in the other”³⁷.

I will define these chain moments in great details in the following passages. Before that, I would like to point out another key difference between the first and second movements, which is the metered notation. The same duality is repeated in the third and fourth movements, where the third is marked *Ad Libitum* and fourth is *A Battuta* again.

The second movement can be divided into three main parts: the first part is from the beginning of the movement to rehearsal 36; the second part begins at rehearsal 37 and runs to 49; the third part is from rehearsal 50 to 61. If we define the texture of the first movement to be linear and contrapuntal, the second movement may be seen as chordal, applying to both the solo violin and orchestra. The six types of orchestral textures that we mentioned in the first movement are being developed in this longer movement, while new elements are introduced in between.

e. from the beginning of the second movement to rehearsal 36

The materials of this section can be divided by the expression marks in Italian, *rude* and *soave*, which composer himself indicated in the score (particularly for the violin solo part). We can find a much earlier example of his use of these two terms in “Five Songs” (1959). The word *rude* in Italian means angry. The materials of *rude* are

³⁷ Nikolska, 328.

either two or three-note chords that consist of interval pairing 1+6 and sound dissonant and harsh, or sequences of three-pitch pattern that are fast and naughty. The English translation for word *soave* is “sweet,” and the music with a melody consisting of interval pairing 2+5, or a major second plus perfect fourth or fifth, fits this designation.

The chain technique is adopted for structuring the micro sections, beginning right at the first intersection of rehearsal number 24. Usually each link comprises two rehearsal numbers. **Figure 37** below displays such structure. We can see that the solo violin and orchestra rejoin at rehearsal 35 after a period of interplay of the chain links. To define the boundaries of each link is not difficult, due to the clear textural changes in both of the solo violin and orchestral parts.

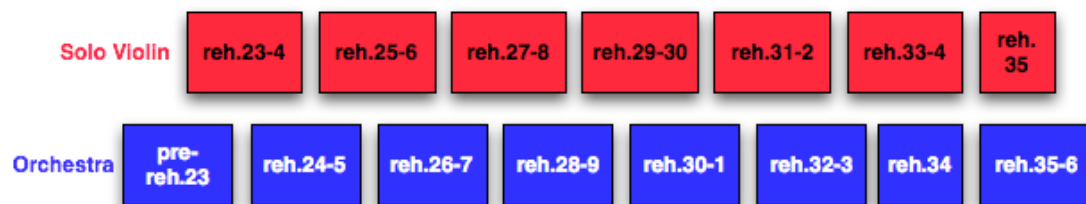


Figure 37

Illustration of chain form in the first section of Movement II from pre-rehearsal 23 to 36

The material at the beginning of the second movement reminds us of the introduction to the first movement at the very beginning of this piece. However, they have different instrumentation. Instead of the solo violin, the tremolo is now played by: clarinets, trumpet 2, and strings except double bass. Then the group continues to play a series of chords while the xylophone enters to play glissandos that reach several high pitches. This orchestral texture continues until the end of rehearsal 23, while the solo violin enters at the beginning of rehearsal 23. I consider this moment the first overlap of the chain form in this piece. The OM analysis shown in **Figure 38.1** indicates that the group of chords is composed primarily of four-note chords. All

twelve pitches are employed in both sections (we will continue to see this feature, which applies to most of the rehearsals of this movement) in comparison with the first movement, where only a few places contain all twelve pitches. Some features of these chords are worth nothing: the pitch class set (0 1 5 6), forte |4-8| is employed eight times, and we can see that most chords associated with this pc set are symmetrical and often consist of perfect fourth/fifth and tritone. We can also discover this through the object *multi-interval*, the results of which show an emphasis on interval classes 5, 6, 4, 1, while ic 3 (minor third) is completely excluded in this passage. Another observation is that the lowest and highest pitches of this part both emphasize the pitch F.

Now let us observe the materials of the solo violin, which begins right at **Figure 23** with the expression mark *rude* and ends before rehearsal 25. Because the new materials of the orchestra begin at rehearsal 24, it creates the second overlap of the chain form. Let us observe the OM analysis shown in **Figure 38.2**, as before, the object *multi-prime* gives us prime forms of each of the chords played on the solo violin. We can see that these chords are either constructed with interval classes 1 and 2 or ic 1 and 6. Through the object *multi-interval* that returns the intervals between each note of a chord (low to high order), we can see that three kinds of intervals are employed: the minor second, perfect fifth/fourth and tritone. The chord-sequence editor on the top shows the ten pitches employed and object *12tone-diff* tells us that two pitches, C and C#, are excluded from this part, which makes the ten-pitch scale symmetrical. The next chord sequence editor shows us the range of pitches used in this passage, in which we observe that the pitch G is employed both as the lowest and highest pitch and across three octaves. The voice-leading object shows us voice-leading of the low and high voices, of which only the interval classes 1, 2, 5, and 6 are

employed.

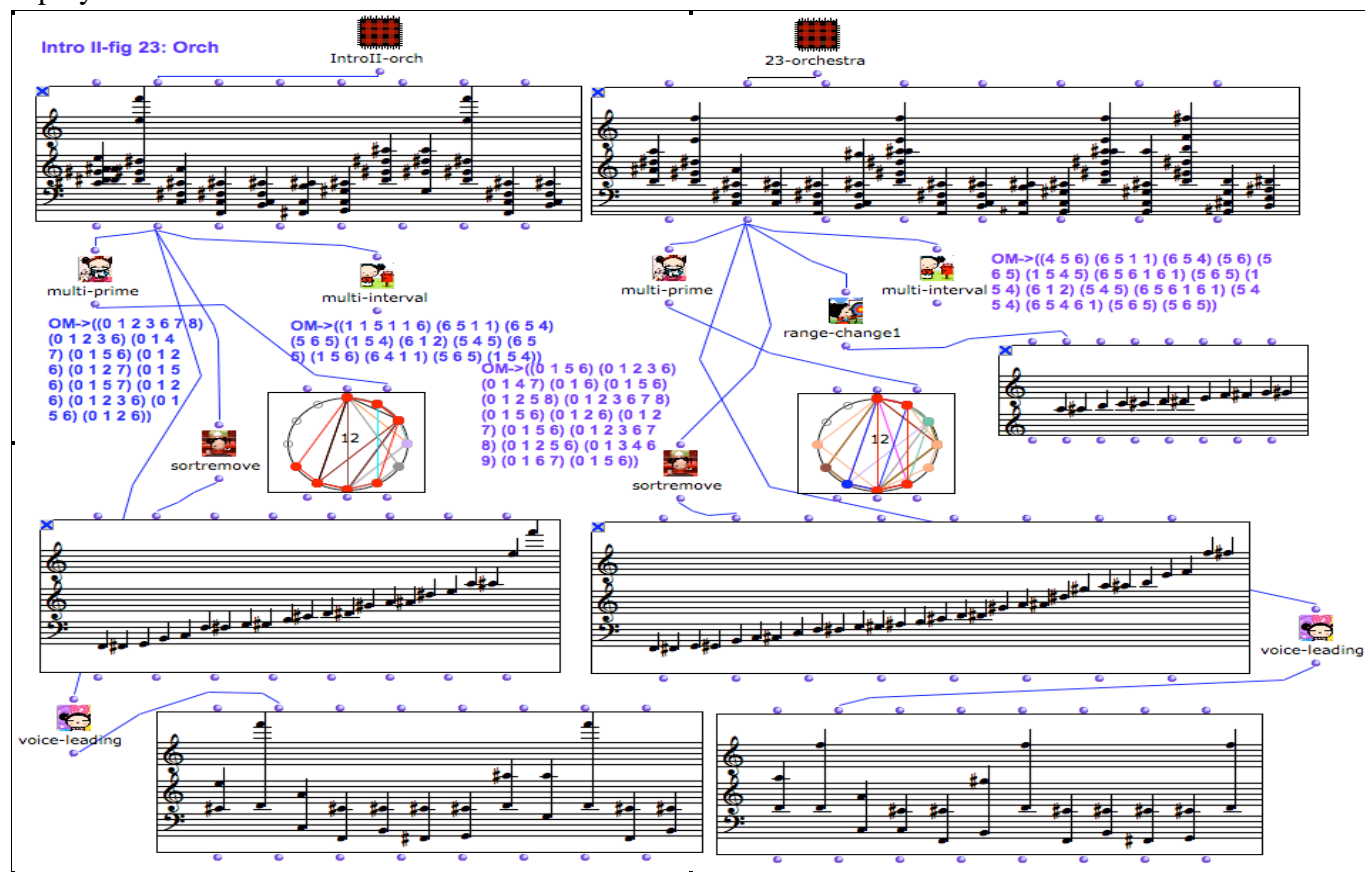


Figure 38.1

OM analysis of the orchestral part at rehearsal 23

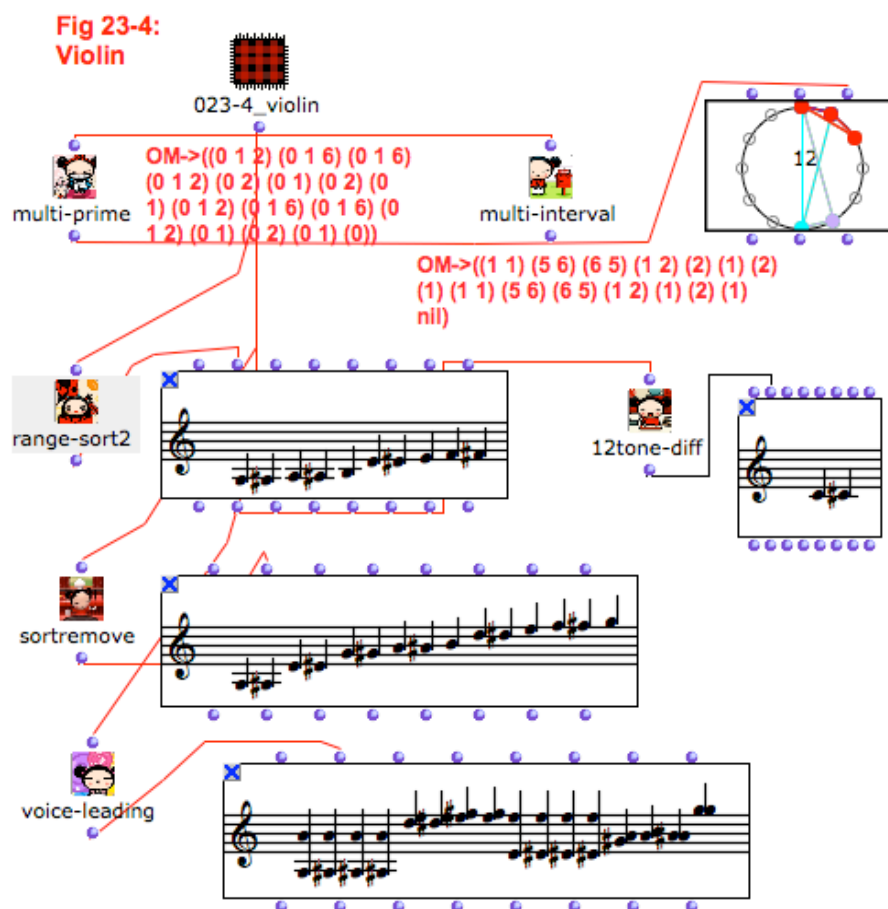


Figure 38.2
OM analysis of the violin solo at rehearsal 23-4

New materials of the orchestra begin at rehearsal 24, with strings separated into two functions: violins I play a slow moving melody mainly by steps beginning at F4; violin I and viola play pizzicato unison on certain pitches of the violin I melody. Clarinets and bassoons together play a group of staccato chords, which according to the OM analysis in **Figure 39.1** are all major triads (0 3 7). The downward scale on violins I from G#4 to A#3 utilizes all twelve pitches. On the other hand, violin solo begins to play the first *soave* melody at rehearsal 25. It is very clear to see in the OM analysis shown below that interval pairing of (2+5) is employed. We observe that F is also emphasized in the melody: the first two of the four phrases begin at F5, and the

last two phrases reach F6 before moving downwards. The BPF editor shows us the melodic contour of this passage. The violin begins the *soave* passage at rehearsal 25 while the orchestra continues from rehearsal 24, another overlapping of the chain form is created.

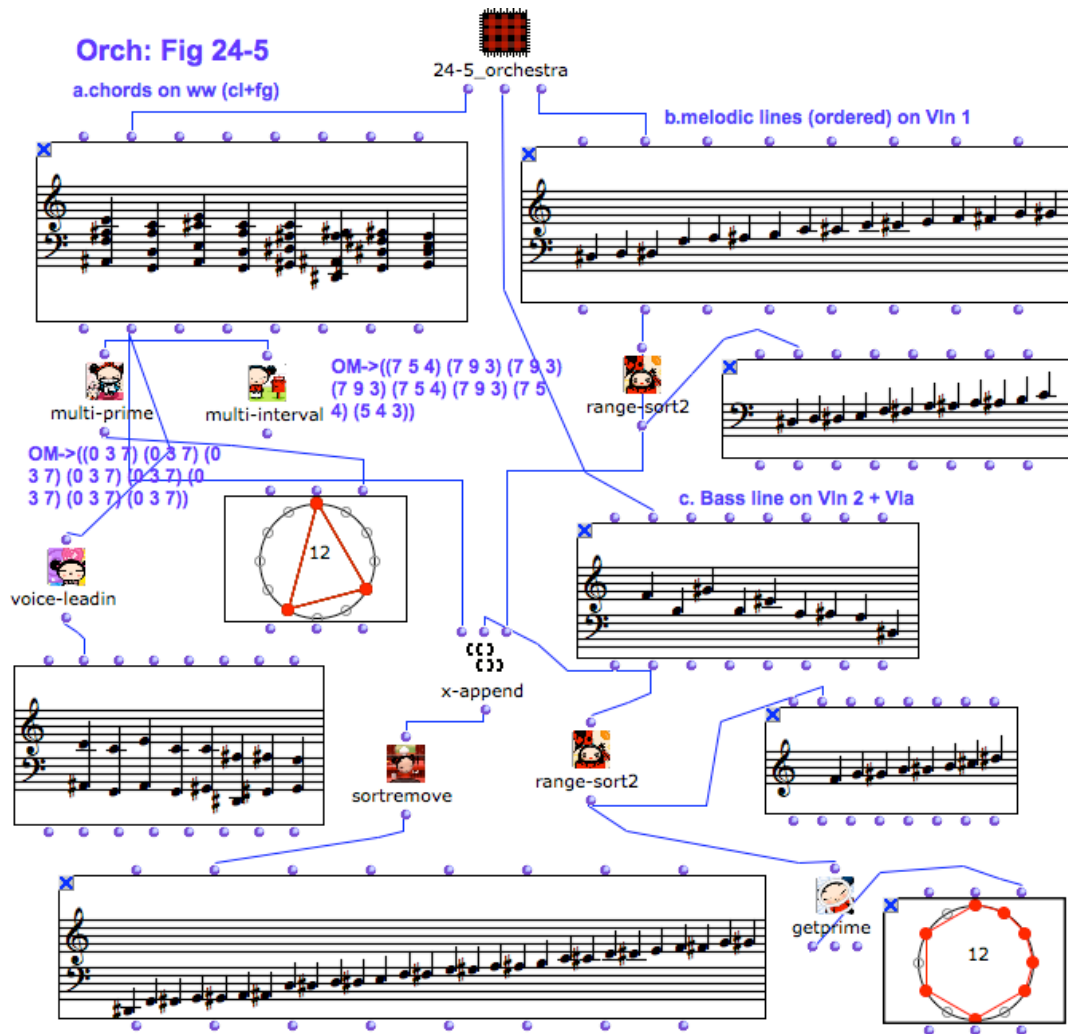


Figure 39.1
OM analysis of the orchestral materials at rehearsal 24-5

At the end of rehearsal 25, a “new” material appears: the fast passage played on clarinet, bassoons and piano, followed by a sustained chord on the piano right at rehearsal 26. This is in fact not a completely new material because it has appeared in movement I. However we observe that this material was not developed in movement I

but begins to be developed here from rehearsal 26 to 27. Let us look at **Figure 40.1**; as before, the OM analysis focuses on the pitch materials. I divide the space into several sections under letters A, B, C, and so on, which correspond to each phrase of the harmonic contents, and the order follows the order of appearance over time. The first chord-sequence under the letter A displays the pitch-field of the fast passage right before rehearsal 26, which is played on clarinets, bassoons and piano.

We can see the result from the second chord-sequence (CS) editor: nine pitches are employed here. The small CS editor next to it shows the three pitches C#, D, and D# that are excluded from the pitch materials in this part. Let us now look at the two chords under letter C for a moment: the first chord corresponds to the sustained chord that is played on piano. The chord-sequence editor under letter B shows the next fast passage, as before played on clarinet 1 and two bassoons along with the piano. It is followed by a second sustained chord, which corresponds to the second chord of the CS editor under letter C. We can see that eleven pitches are employed here, excluding pitch B. And from the results after the objects *multi-interval* and *multiPrime*, we can see that the two sustained chords are both symmetrical and share the same prime form (0 1 2 3). The chord-sequences under letter D and E correspond to the measure before rehearsal 27. There are eleven pitches employed on the first fast passage in the measure before rehearsal 27; the pitch G# is excluded.

Regarding the orchestration, flutes, oboes and clarinet 2 play this fast passage instead of the bassoons and clarinet 1; the xylophone joins to play the high note F at the end of this phrase. If we examine the chord created at the end of this phrase (please refer to the CS editor under F), we can see that a new symmetrical chord appears that has a prime form of (0 1 2 6 7). The next fast passage at rehearsal 27 is like the one at rehearsal 26. However, the violin solo line begins a new section with new materials, which I will discuss in the next paragraph. Now, let us continue to see the passages of

the orchestra in rehearsal 27. Please note that CS editors under G and H correspond to the second and third fast passages in this section and disregard the first one because it is exactly the same as the passage at the measure before rehearsal 27. Here we can see that another group of nine pitches employed in the second fast phrase excludes pitches G#, A, and A#, in contrast to C#, D and D#, as if it is transposed. The CS editor under H indicates another group of eleven pitches employed in the last fast passage, which excludes A. It is interesting to see the four chords in the CS editor under F, where we see two types of prime forms which are associated to these chords: (0 1 2 6 7) and (0 1 2 3). Three of the four chords are structured as symmetrical chords.

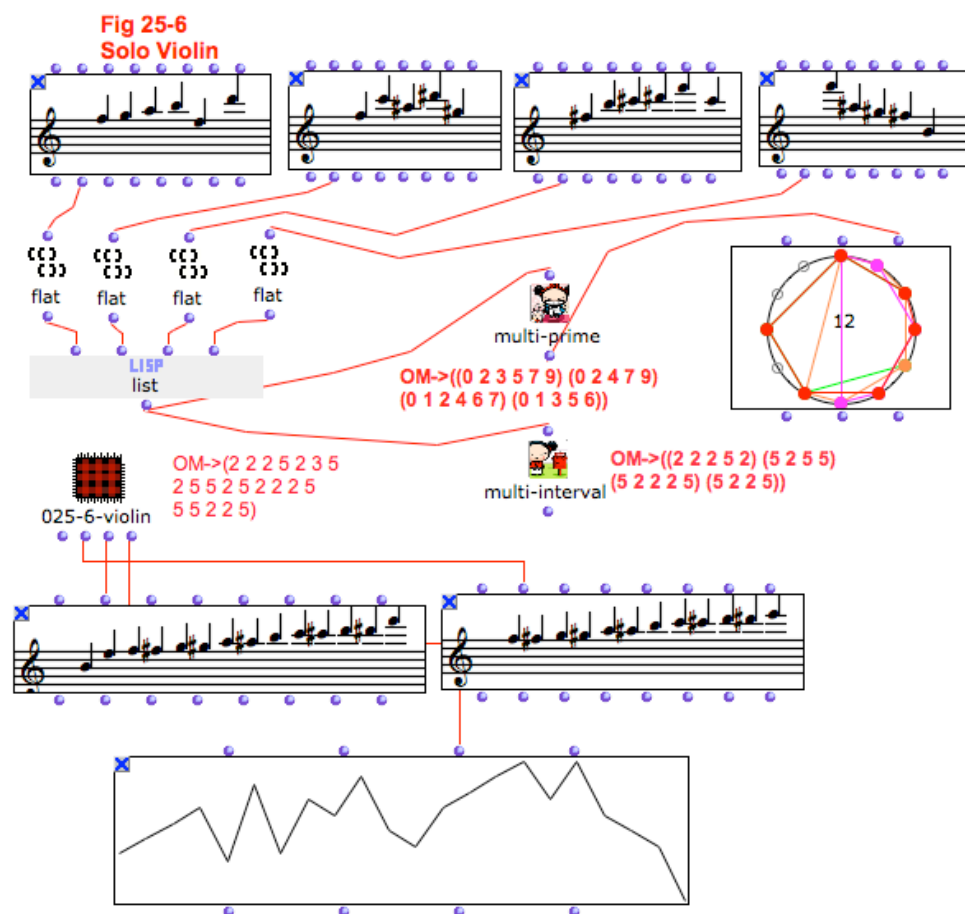


Figure 39.2
OM analysis of the violin solo materials at rehearsal 25-6

As I mentioned before, the solo violin begins a new phrase at rehearsal 27, while the orchestra continues until the end of this passage. It creates another overlapping moment of the chain-form. Let us look at **Figure 40.2**. I divide the melody into four sections, marked by small letters a, b, c and d. Passages of a, b and c are within rehearsal 27 and share features such as ending with dissonant chords, which consist of two notes a thirteenth apart. Interval classes 1 and 2 are the main intervals employed in the melody. In most cases, interval class 1 is employed when the melody is going down and ic 2 when going up. I consider the last passage (marked d) to be a transition passage, because each small phrase consisting of four notes is moving up first by step, A4-A#4-B4-B#4, then by minor thirds, B4-D5-F5-G#5. We will talk about this again in the next paragraph, together with the new materials of the orchestra.

Now let us focus on the materials of a, b and c. I would like to know the relationship between the solo violin line and the orchestra, thus I include the chords of the orchestra: e, f and g represent the chords that either sustain or are an attack played by the instruments of the orchestra. When we compare the pitch materials of a and e with object *compare2lists-diff*, we see that three of the four pitches in the chord e are not present in the melody passage a. They are complementary. When we compare b and f, we see that, except for the pitch F, in the five-note chord that is not included in melody, all other four pitches share the same pitches of the melody in b. When we compare c and g, we see that two pitches are excluded from the six-note chord. From the CS editor at the lowest part, we see that the pitch field of the melody spans from C#4 to G#6, constructed mainly by steps (ic 1) except two tritones in the lower and highest register. All twelve pitches are employed in the melody.

While the four-note fast sequence continues on the solo violin, at rehearsal 28 trumpets and the trombone each play a counterpart melody that forms a chord. At the

same time, strings also divide to play either sustained three-note chords, or pizzicato to form an arpeggiated chord. We can find out which type of chords they are through the OM analysis of **Figure 41**. The chord sequence under letter b begins from three-note chords, which are mainly major triads (0 3 7), followed by four-note chords (0 1 6 7) then five-note chords (0 1 2 6 7). We observe that the four and five-note chords are constructed as symmetrical chords. There is a melodic line to accompany the solo violin, which is indicated in the CS editor under letter c and played on trumpet. We see the result of object *forintel-h*, which indicates an interval pairing of 1+3. At the very top of this figure, the CS editor under “a” is the melody played on the solo violin, we can see from the result after object *forintel-h* that the melody consists of interval pairing (2+5) only, and all twelve pitches are employed. On the other hand as regarding the orchestra, eleven pitches are employed (only B is excluded).

An intersection appears at rehearsal 30, when the trumpet begins to play a staccato melody (D5-B4-Bb4-A4-Ab4-F4) and the clarinets and bassoons join together to play a four-note chord sequence. The solo violin continues until rehearsal 31 to begin another *rude* section. **Figure 42** indicates the analysis of both the violin and orchestra at rehearsals 31 to 32. As before, the letters marked in blue correspond to the orchestra, while red indicates the solo violin. As you can see, the left part of the space is for the orchestra and right part for the solo violin. Let us look at the orchestra first. The two chord-sequence editors on the very top show the notes of the two melodic lines played on bassoon 1, the clarinet 1 (latter). We can see from the result that interval pairing 3+1 is adopted for creating the melody. The large CS editor on the second line includes a group of chords corresponding to the chords that begin at the second measure after rehearsal 31, played first on clarinets, bassoon 2, and trumpet 1 then joined by strings. The reader may compare this group of chords with those in **Figure 37**, and can see that it is indeed a continuation from the previous passage,

because many of the chords share the same prime. Separation this section of the orchestra is simply for the convenience of the comparing to the solo violin part.

An intersection appears at rehearsal 30, when the trumpet begins to play a staccato melody (D5-B4-Bb4-A4-Ab4-F4) and the clarinets and bassoons join together to play a four-note chord sequence. The solo violin continues until rehearsal 31 to begin another *rude* section. **Figure 42** indicates the analysis of both the violin and orchestra at rehearsals 31 to 32. As before, the letters marked in blue correspond to the orchestra, while red indicates the solo violin. As you can see, the left part of the space is for the orchestra and right part for the solo violin. Let us look at the orchestra first. The two chord-sequence editors on the very top show the notes of the two melodic lines played on bassoon 1, the clarinet 1 (latter). We can see from the result that interval pairing 3+1 is adopted for creating the melody. The large CS editor on the second line includes a group of chords corresponding to the chords that begin at the second measure after rehearsal 31, played first on clarinets, bassoon 2, and trumpet 1 then joined by strings. The reader may compare this group of chords with those in **Figure 37**, and can see that it is indeed a continuation from the previous passage, because many of the chords share the same prime. Separation this section of the orchestra is simply for the convenience of the comparing to the solo violin part.

After the joint point at note D4 played on all strings except double bass, the voices are separated into two, three, five and four-note chords. They rejoin again on note G#3 before reh. 33. On the other hand, the solo violin emphasizes the F and the melody around this pitch is moving mainly by ic 5 (perfect fourth or fifth). We can see from the OM analysis in **Figure 43** that the last three chords in the CS editor on the left are structured with a minor second on the top, which intensifies the harmony. If we compare this with the chords played on the solo violin, we can see that they do not share most of the pitches, except the F, which appears in the solo violin as a passing

note. The fact that interval class 1 and 5 are employed in the chords of both the violin and strings provides evidence that this is a common feature for the harmonic structure in this piece.

The climax begins at rehearsal 35, where the whole orchestra joins in playing the triplet chord. We can see in **Figure 45** that this is a twelve-note chord, which is structured symmetrically as well. This is the first time ever in this piece that a twelve-note chord is used. Then the strings follow the solo violin, which plays an arpeggiated passage of two combined four-note chords, E-G#-B-D# and A#-D-F#-A. There are not alien to Lutosławski's music; many of the twelve-note chords are constructed with simple intervals, in many cases a pair of intervals such as 3+4. Rae (see **Figure 44**) labels the four-note chords that contain only interval classes 3 and 4 by capital letters from A to G; there are all together seven such chords³⁸. There are also three additional chords, which he labels H, J and K, containing interval pairing 5+3. In the case of the solo violin, the chord type F is 3-4-3 and G is 4-4-3 are employed for creating the climbing melody on the solo violin.

Let us come back to the chords played in the orchestra as shown in the CS editor on the left. The object *multi-interval* indicates that the interval pairing 3+5 is employed to build the twelve-note chord. If we look carefully at the chord, we can see that except for the two perfect fifths in the outer voices, chord type H is 3-5-3 is employed for the construction of this large chord. Three H chords interlock with each other to build the chord aggregates: F3-Ab3-Db4-E4 plus E-G4-C4-D#5 and D#5-F#5-B5-D6. Except the twelve-note chord and the last chord of this chord sequence, the rest are all built with interval pairing 3+4. The aftermath of the climax follows with a lyrical section, which ends the first section at the end of rehearsal 36 and continues to the next section that begins at rehearsal 37.

³⁸ Rae, *The Music of Lutoslawski*, 54.

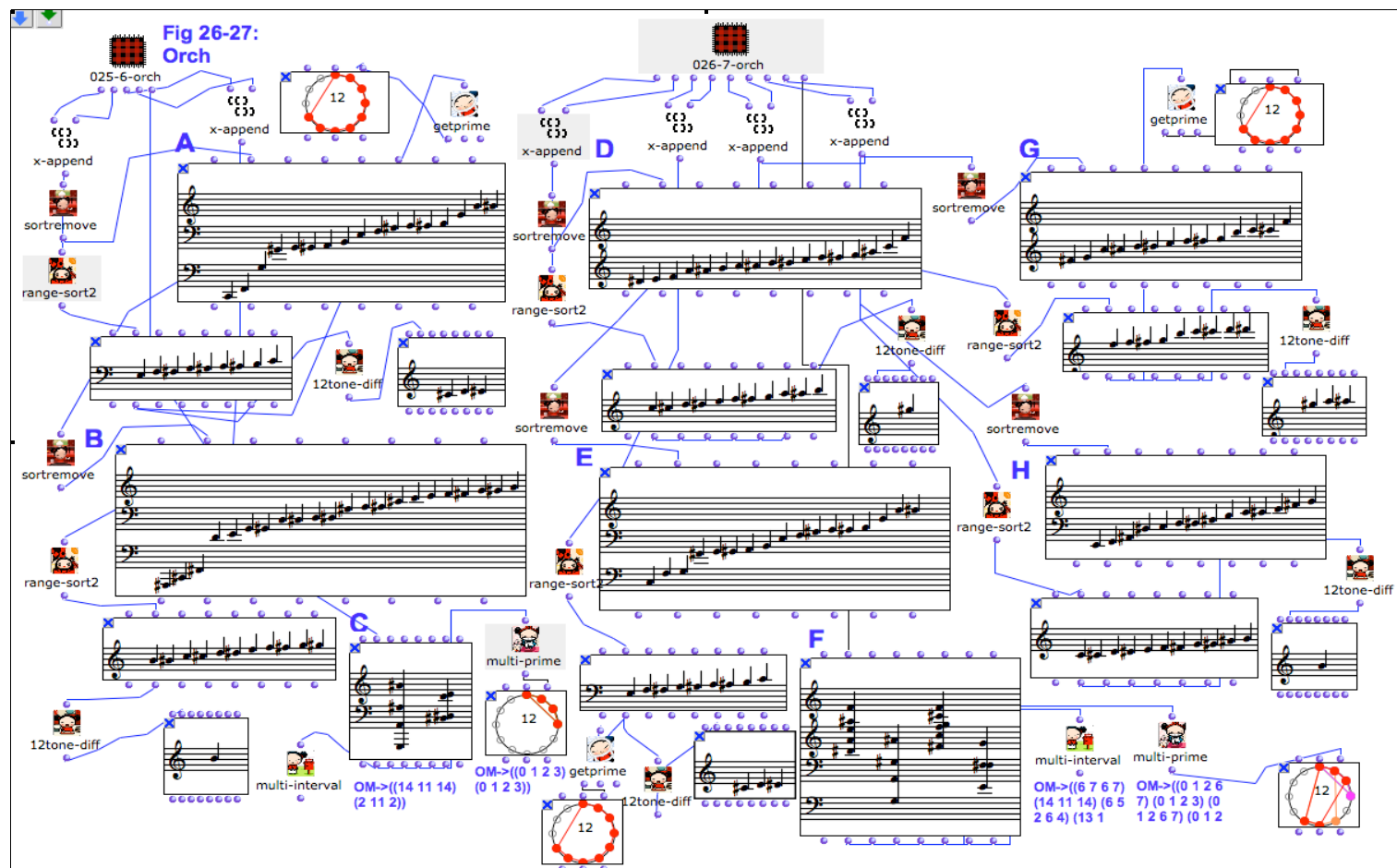
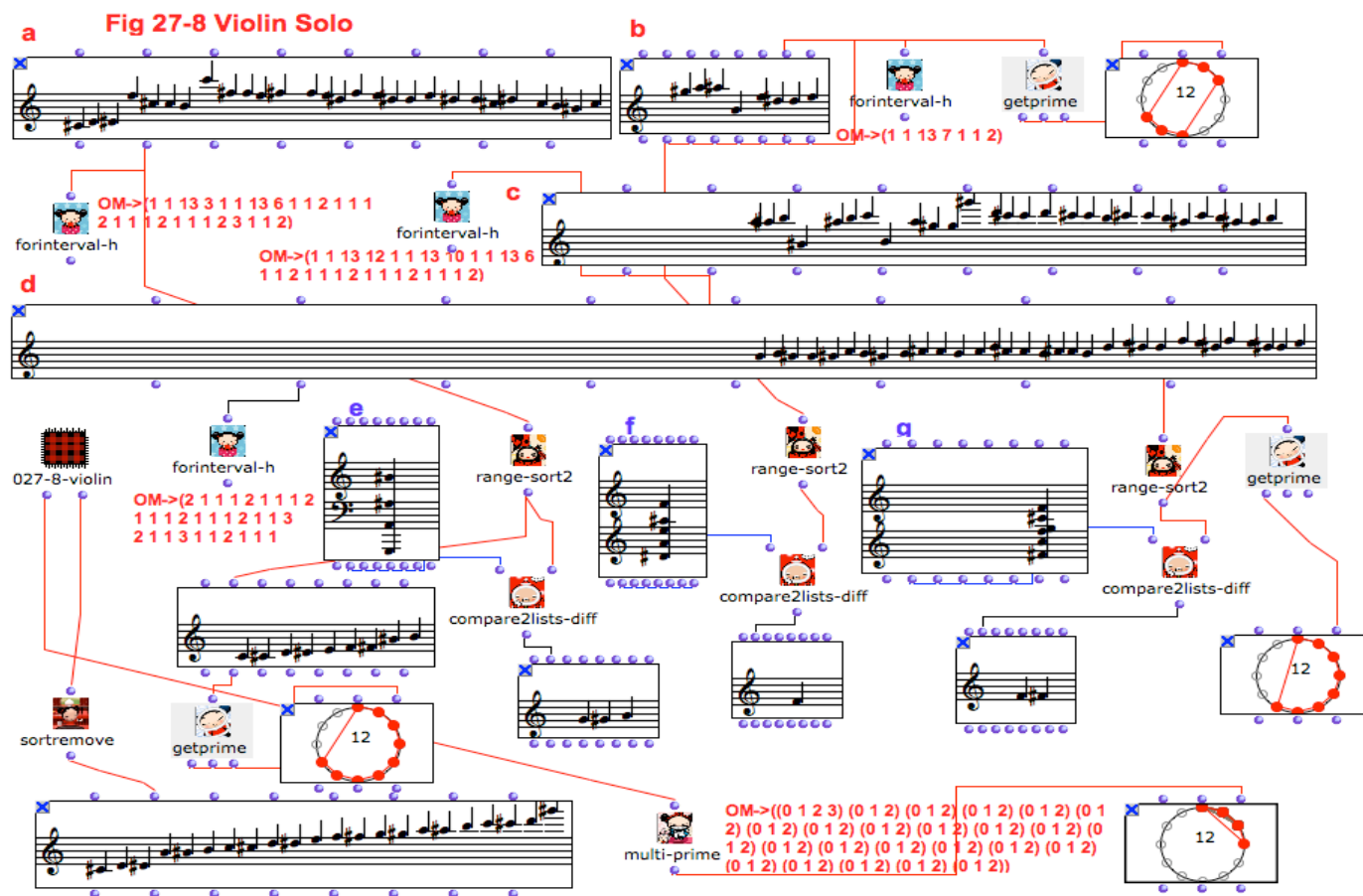


Figure 40.1
OM analysis of the orchestra materials at rehearsal 26-7



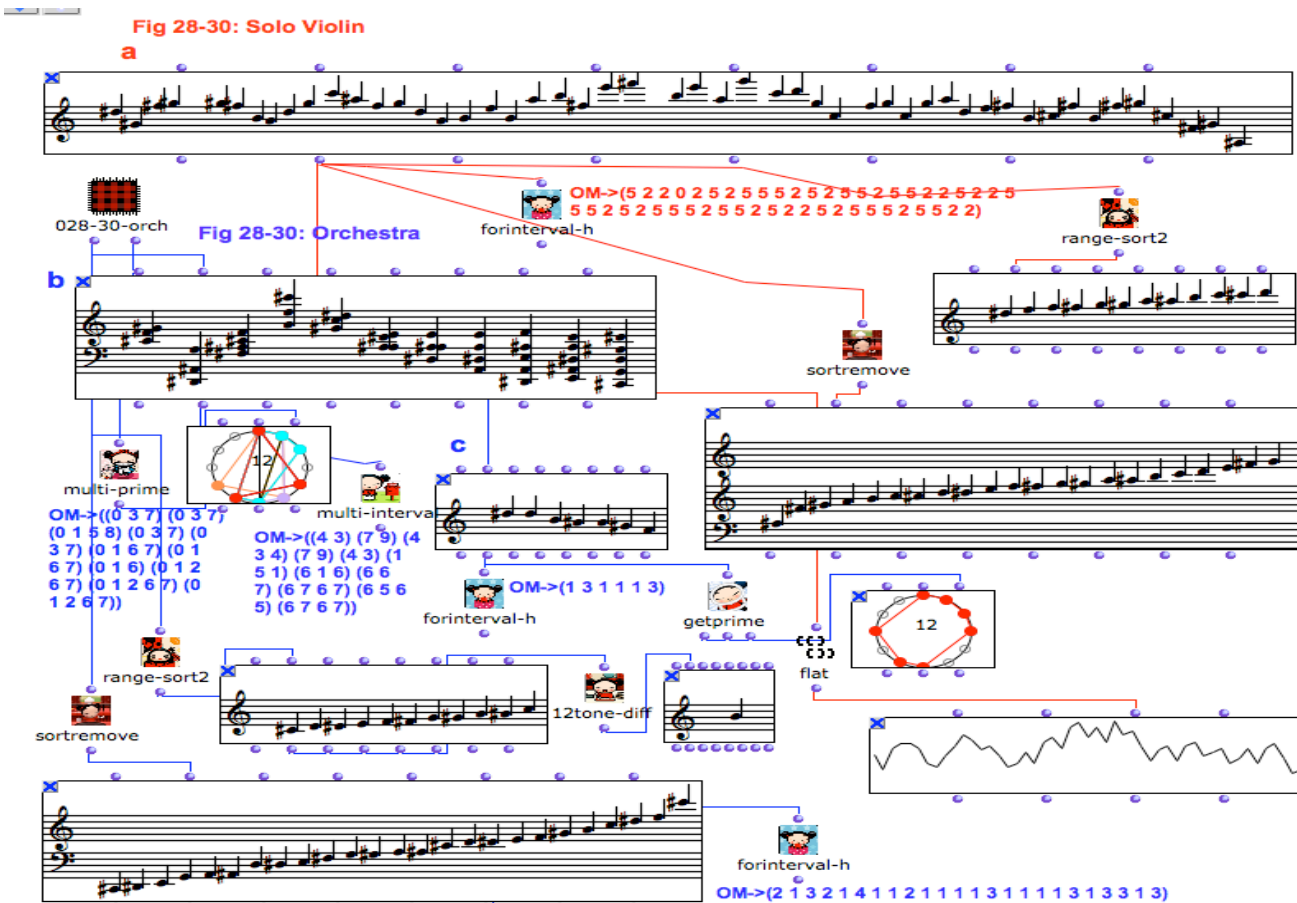


Figure 41
OM analysis of rehearsal 28-30

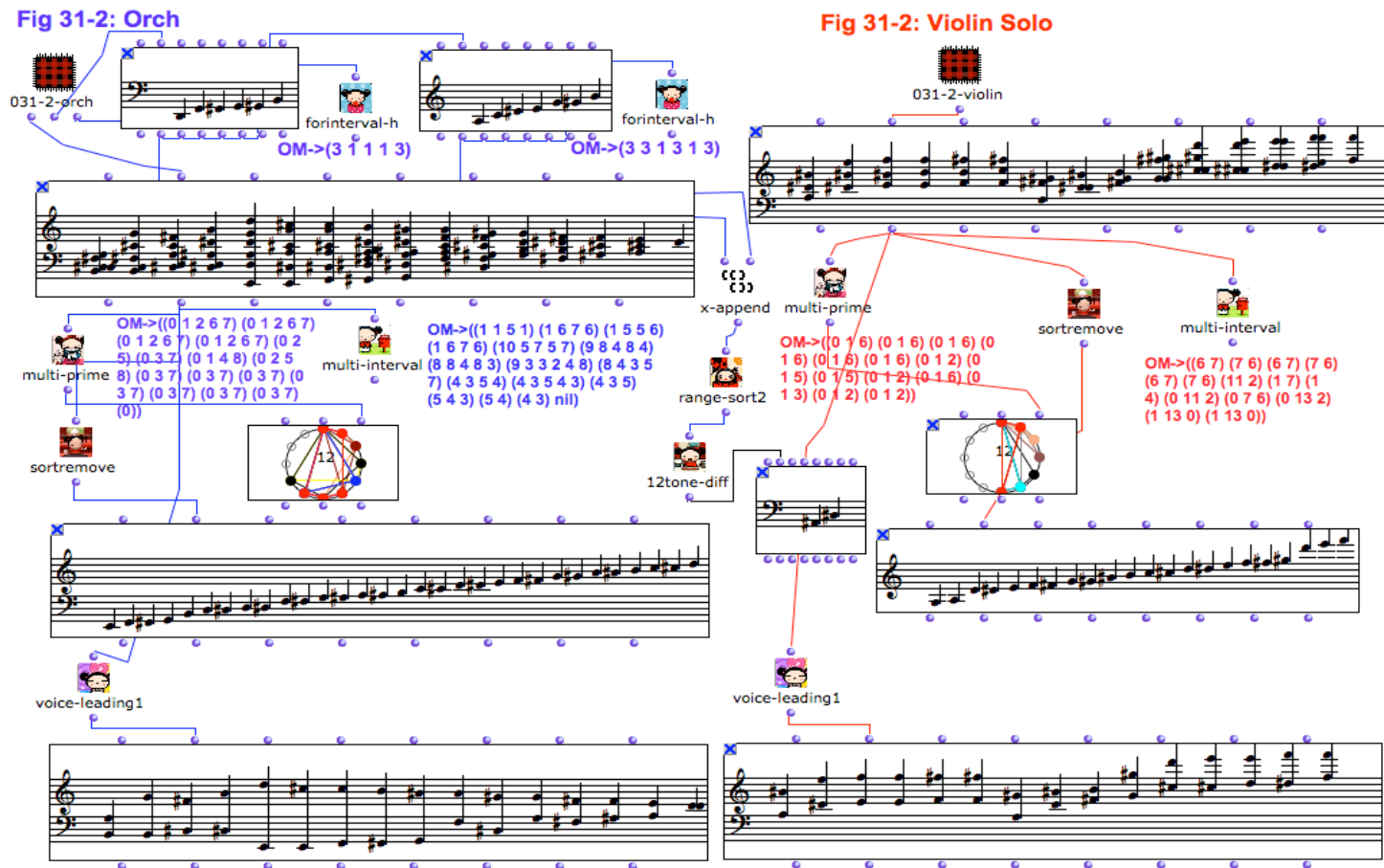


Figure 42
OM analysis of rehearsal 31-2

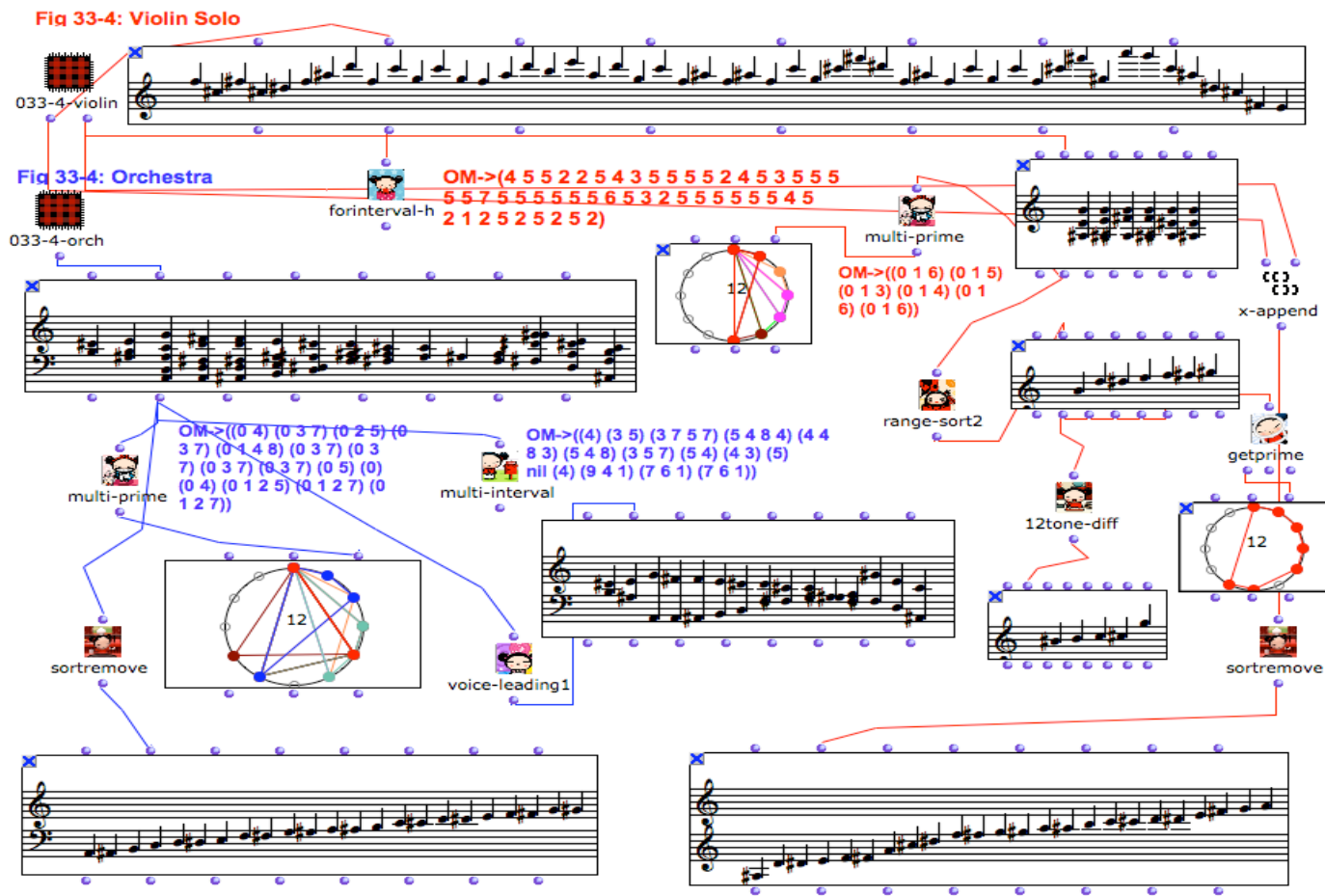


Figure 43
OM analysis of rehearsal 33-4

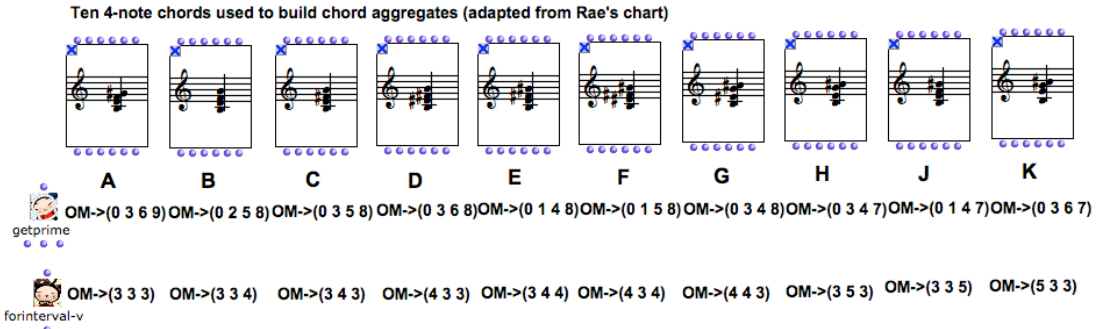


Figure 44
Rae's chart of the types of four-note symmetrical chords

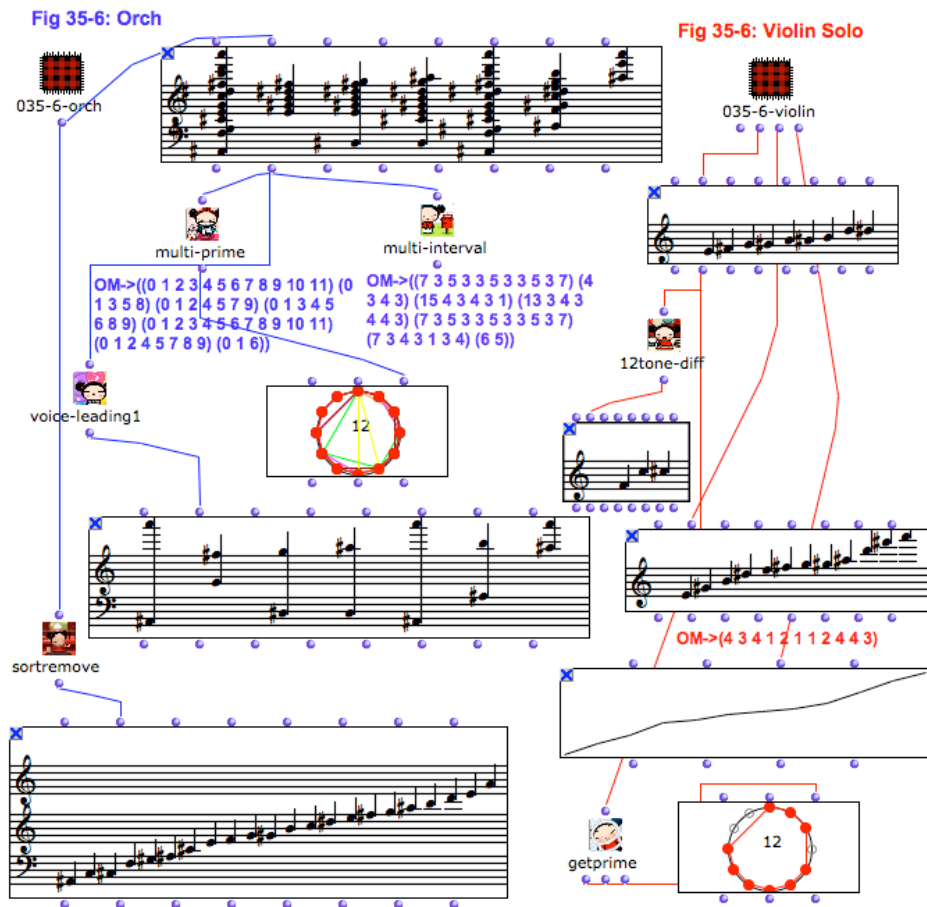


Figure 45
OM analysis of rehearsal 35-6

f. From rehearsal 37 to rehearsal 49

Before I continue with analysis of the individual sections, it will be essential to see how the chain form is applied to the second section. Please refer to **Figure 46**, where we can see that the pattern of two rehearsal numbers of each chain phrase remains as it was in the first section. One exception appears in the orchestra during the penultimate moment, which contains three rehearsal numbers before the final tutti section of rehearsal 48-9.



Figure 46

Illustration of chain form in the second section of Mov II from reh37 to reh49

At the end of rehearsal 36, the climax that appeared earlier is quickly replaced by violins playing on the high note A6, which leads to the next section of the second movement. Violins begin to imitate the *rude* vivid four-note pattern, which appeared earlier at rehearsal 27 on the solo violin. Please refer to **Figure 47**; the CS editor under the letter d in blue displays the pitch material in chords. Each group of four notes shares the same prime of (0 1 2 3). The fourth note of the pattern corresponds either to the bass notes or top notes of the chords that are played on the flutes and oboe. Two flutes and oboe play a group of three-note chords, which are all major triads. The CS editor under letter e indicates these chords. Since the top and bass notes are emphasized, we may also see how they are related, first, by utilizing *voice-leading1* to find the outer voices. Then I use *patchforintel-h* to find out their relationship, which indicates in blue that only interval class 3 and 4 are considered. The melody of the solo violin, on the other hand, is created by only the interval pair 5+2, which we

observe from the results under the CS editor marked a and b, as well as c, which belongs to a new section yet continues to follow the rule.

While the second phrase of the solo violin starts at rehearsal 39, strings begin a new section with glissandi. The glissando material has appeared before on the xylophone, but here it is transformed and developed and played on the strings instead. The vibraphone and chimes play the top notes of the three-note chords of the strings. We can see these chords from the CS editor under letter f. In comparison to the chords under e, there are major triads as well but they do not connect with each other by major or minor thirds (4 and 3); instead there are big leaps. Please refer to the result at the bottom left after *patchforintel-h* 9 8 6 1 1 3 4 9. After the climax, two sites of intersections appear: one at rehearsal 39 where strings begin the glissandos yet solo violin continues the *espressivo* melody; the second at rehearsal 40, where the string glissandos continue but the solo violin begins to play short repeated notes in the high register. Let us look at **Figure 48**, where the third intersection appears.

It is clear that the melodic line of the solo violin follows the rule of interval pairing 5+2. Ten pitches are employed here—all except C and F. It is interesting that the symmetrical planning of the pitch field is revealed in the melodic line. Please refer to the third CS editor on the left, where only interval classes 2 and 1 are employed. On the other hand, flute 1 and clarinet 1 play a group of arpeggiated chords, which are mainly major triads plus two types of three-note patterns. There are minor seconds plus major thirds (0 1 4) and minor seconds plus tritones (0 1 6). The piano begins to play with the vibraphone the arpeggiated major triads at rehearsal 43, while the strings play *arco* instead of *pizzicato* to accompany these chords. We can see from the analysis under the *voice-leading* patch that interval class 4 (major thirds) is mainly used to connect these chords. If we compare the pitch fields of both the violin and the orchestra, we find that they mostly overlap within a relatively small range from G4 to

G6 in the orchestra and B4 to F#6 in the solo violin.

The solo violin uses a pentatonic scale from rehearsal 46 until 47. The orchestra plays a group of repeated chords from four notes to twelve notes. **Figure 49** above indicates these chords, however it is not clear how they are built with different instrumental groups. In fact, we do not need tools for this observation. It is clearly noted that different types of the four-note chords combine together as chord aggregates for these giant chords. For instance, at rehearsal 48, violas and violin II play together a half-diminished seventh (type B), and the first violins are divided to play a type C chord. Then in the next chord, piccolo, flute 1, oboe 1, clarinet 1 and piano play the type H chord. In Figure 49, we can easily observe the voice leading lines that are carefully planned by the composer. The result after the *voice-leading* object indicates the melodic and bass voice-leading lines. Now it is clear to see that both voices are moving towards G#, which is also the pedal tone of this passage (we'll talk about this further in the review of this movement later). The timpani plays on G# to end this section. The repeating material that serves as connections appears at both places in between the first and second sections.

g. From rehearsal 50 to rehearsal 62

The chain phrases of the last section of the second movement appear only in the first half, then both the solo violin and orchestra rejoin at rehearsal 56. We can survey this feature in **Figure 50**.

The last section of the second movement spans from reh. 50 to the end. At rehearsal 50, the violoncello and double bass sections begin to play a recurring downward melodic pattern, while the bass clarinet and bassoons follow it with tremolos and connect with fast melodic cells. Through the OM analysis given in **Figure 51**, the first chord-sequence editor under the red patch "050-51-orch" indicates the pitch materials of each phrases of reh. 50 to 51. We observe clusters of minor

seconds (ic 1) that joint together. Another interesting fact is the emphasis on pitches E and G# in the outer voices: remember that E and G# were also important in rehearsals 47 to 49 (see above). Also, we see the release from G# to A at reh. 51, where the first chord on strings has the outer voices G#3 and A4. The appearance of this chord also marks the beginning of the new section played in the orchestra.

The solo violin continues until rehearsal 52, which marks the first intersection, or chain link, of this section. Now, let us observe the pitch materials of the solo violin, which we can see from the OM analysis shown in **Figure 51**. The four-note pattern reappears with new elements, namely grace notes, immediately followed by the glissandi of two distant notes. Interval classes 1 and 2 are mainly employed at the beginning, then other intervals such as 3, 6, and 5 are used in addition to 1 and 2. At rehearsal 52, the solo violin begins to play a two-note chord and connects the second one by two septuplets. All pitches are played on the solo violin at rehearsal 52, which are connected with interval classes 1 and 2. Strings play two chords in this passage, which is a continuation from rehearsal 51. The bass line moves by step to reach F at rehearsal 53, and the strings then join to play a group of chords with a sustained bass from F to B at reh. 55. At reh. 54, the solo violin begins to play an *espressivo* melody, which moves by minor seconds and major or minor thirds with the occasional fifth/fourth. A group of five-note chords accompany the melody, of which three notes are sustained: the bass notes B1 and F2, and the top note C4.

I consider the music in the first measure of rehearsal 56 to be a connective passage. The solo violin plays an upward scale that contains a pattern of interval classes 2, 2, 1. Trumpets and trombone join together to play Eb4 (or D#), which I call “bass 1,” as shown in **Figure 52**. The solo violin then plays sixteenth triplets with glissandi between two notes in an upward or downward direction. Meanwhile, the woodwinds, brass, and strings each play in turn a staccato eighth-note with grace note

attached to accompany the naughty-sounding violin melody. Through OM analysis, we can see the relationship of these eighth notes, which is indicated in the chord-sequence editor on the first left side of Figure 52. As they are too far apart to see the intervals in between, I use the object *range-change1* to narrow them within one octave. Now it is clear that they are connected mostly by interval class 1 and occasionally connected by ic 2 and 6. Three brass instruments play a dissonant three-note cluster G#4-A4-Bb4 right at rehearsal 57, which is in response to the beginning of rehearsal 56. I then call it “bass 2,” of which G# is emphasized distantly by the double bass. Some instruments of the orchestra continue to play the naughty pattern but instead of taking turns, two instruments play a perfect fifth or fourth together except the second to last one, which is a tritone apart. The CS editor on the third line on the right indicates this feature, and the results are shown under *multi-interval*. Two flutes and clarinets then play groups of sixteenth-note triplets from the third measure after reh. 57, which I consider the appearance of new material and include in the analysis of the materials in rehearsal 58.

The music in rehearsal 58 is a continuation of the previous materials, but instead of the intersection and overlapping of chain form, the solo violin and orchestra join together on the repeated sixteenth triplets on G6 (violin solo and flute 2)-G#6 (Xylophone)-A6 (flute 1). We find another point of similar material in the third measure of rehearsal 58, namely a four-note chord (cluster) played on trumpets and trombones. We can see from the first CS editor on the top left in **Figure 53** that only minor seconds (ic 1) are employed at both places. For the convenience of analysis, I separate the materials of the orchestra into three parts: first, the two cluster chords, which we have indicated above; second, the fast passages from shorter to longer length, which are first played by the woodwinds, then by the strings (shown in the second CS editor on the top); third, the CS editor indicates the chords that are built by

the repeating pitches after the upward scales stop and played in the strings. Through the OM analysis in Figure 47, we see that the pitch materials of the first short passages played on woodwinds contain only minor seconds (ic 1). The first upward scales played on strings contain only minor and major seconds (ic 1 and 2); the second contains minor and major seconds, as well as minor thirds (ic 1, 2 and 3). According to the analysis, the two giant chords shown in the third CS editor are not symmetrical, but one can see that they basically share the same prime form, disregarding a new note added to the previous one. The first is a nine-note chord with prime form (0 1 2 3 5 7 8 10) and the second is a ten-note chord with prime form (0 1 2 3 4 5 7 8 10).

The solo violin, on the other hand is quite straightforward: at first it continues to play a melody that consists of upward and downward glissandi between two notes (interval varies). Then it joins with the orchestra to play an upward scale that contains only minor and major seconds. Based on the OM analysis in **Figure 53**, we observe that the beginning and ending notes of each of the three phrases show a voice-leading melody from G6 to E5, E4 to B6 and G4 to C#7. We also see from the pitch files of this figure in the CS editor on the bottom left that only ic 1 and 2 are employed. When the solo violin reaches high C#7, the orchestra plays a twelve-note chord, which is then reduced to an eight-note chord, and finally concludes on a four-note *fortissimo* chord. In **Figure 54**, we can see the prime and interval structures of these chords; they are neither symmetrical nor structured with the types of chords with ic 3 plus 4 or 3 plus 5. The solo violin line can be divided into three parts: first by leaps of ic 6, 4, 5, 3 in a downward motion; second, by minor and major seconds, also downward, with the last part comprising several passages that contain only ic 5, 6 and 1. Strings play pizzicatos jointly on a six-note chord, which contains ic 4, 5 and 6 with a bass note G3 and top note Bb4. The solo violin also plays pizzicato on a two-note chord A3 and Bb4, which builds on the pitches of the strings.

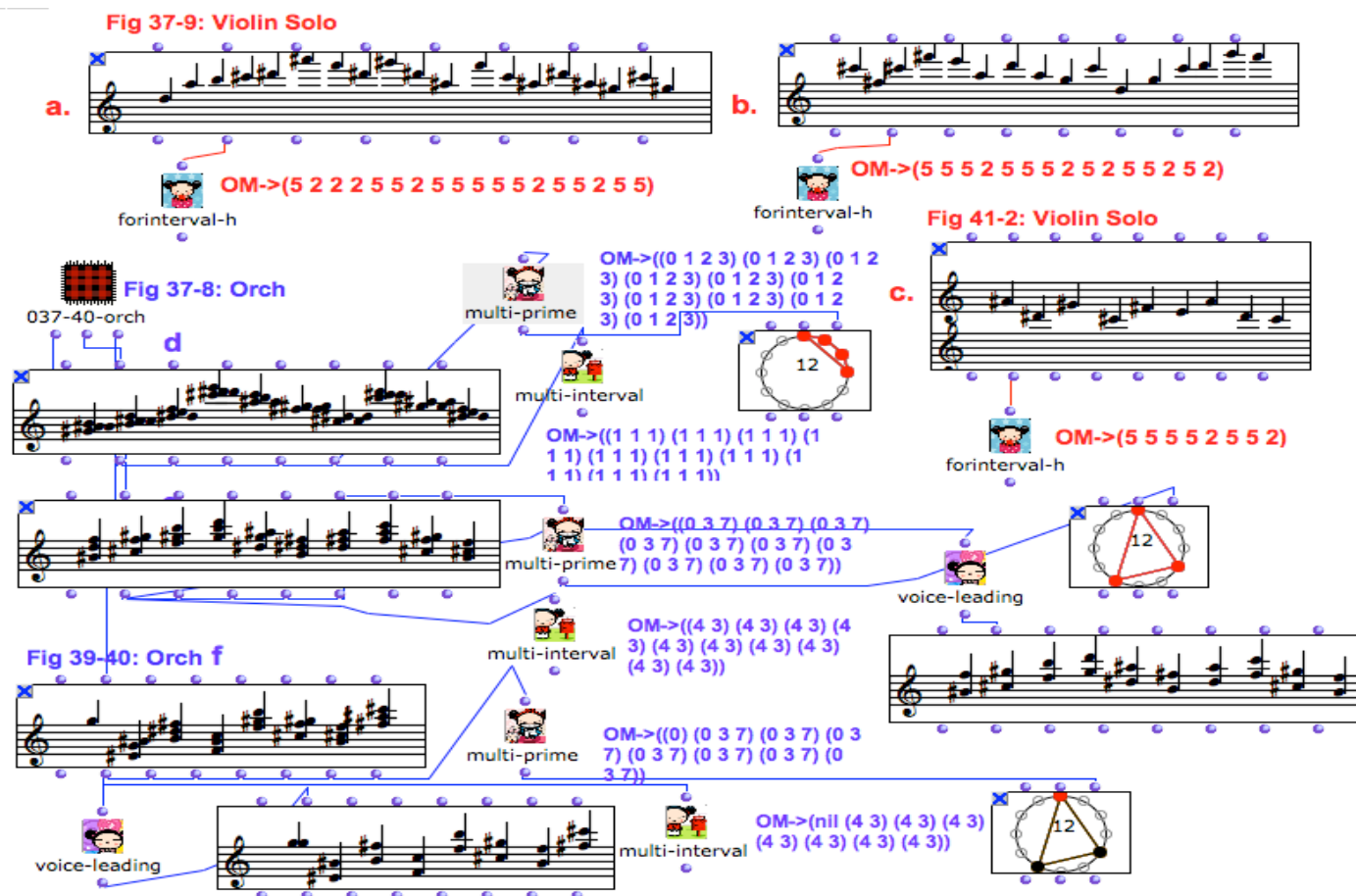


Figure 47
OM analysis of rehearsal 37-42

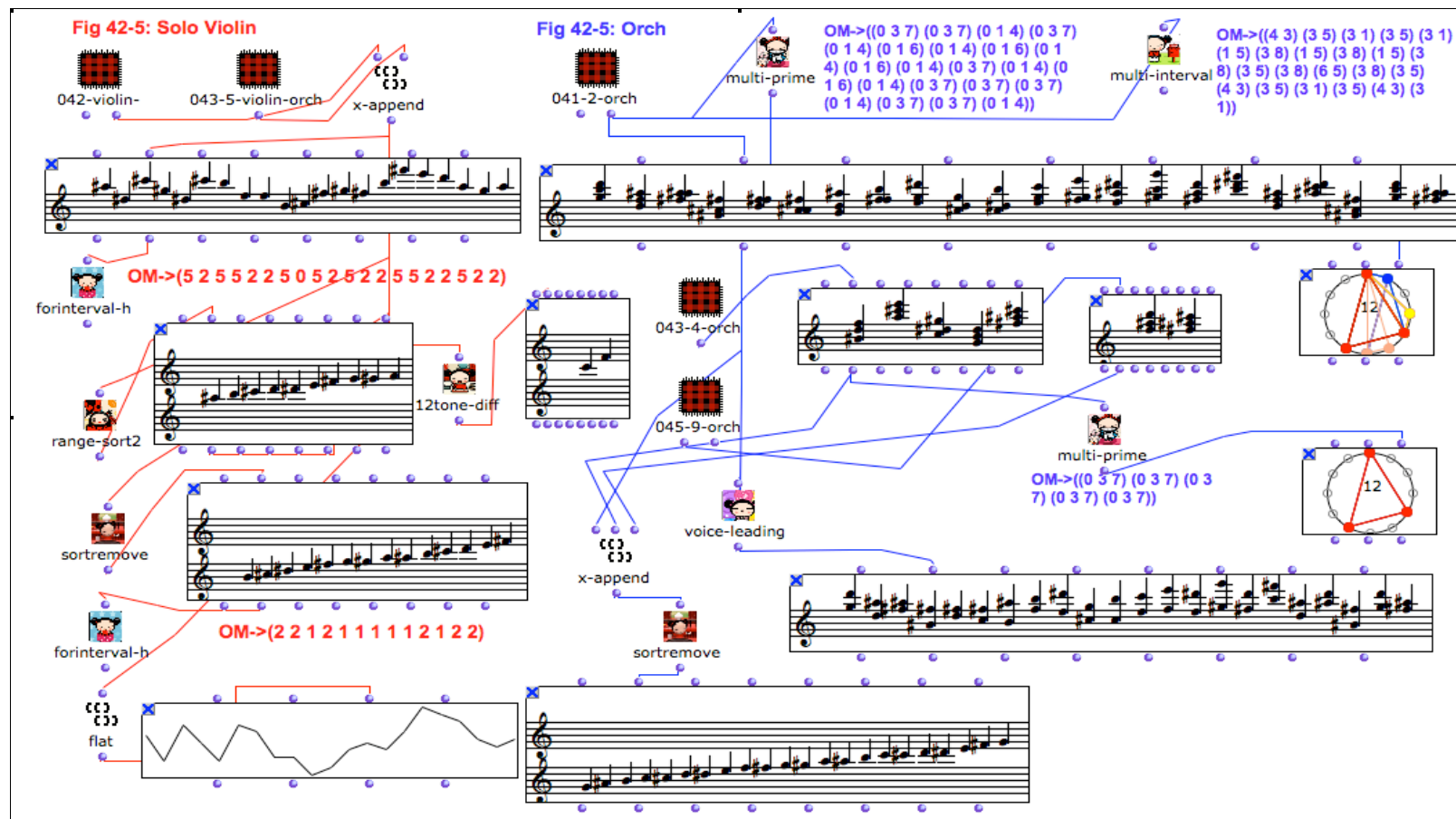


Figure 48
OM analysis of rehearsal 42-5

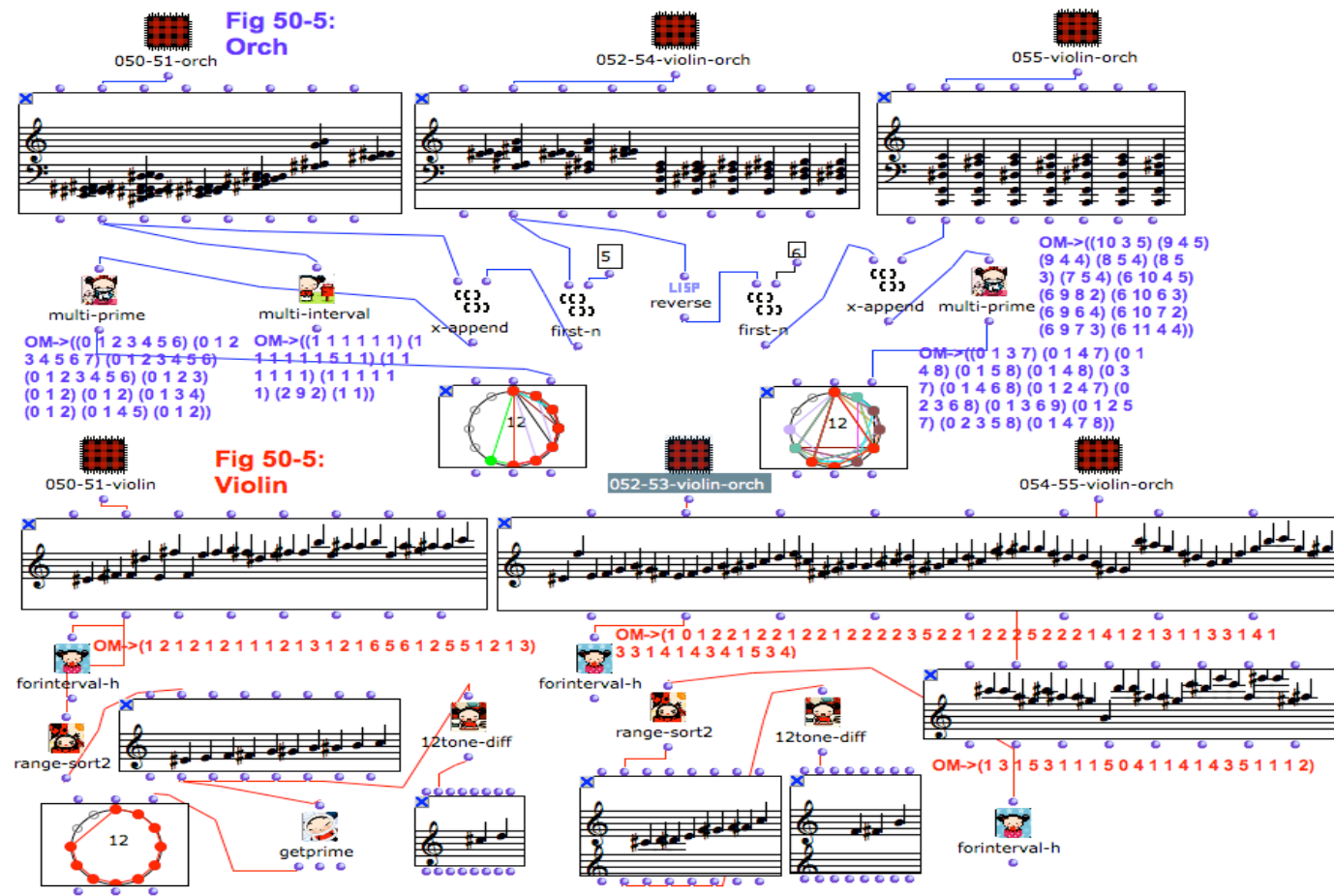


Figure 51
OM analysis of rehearsal 50-5

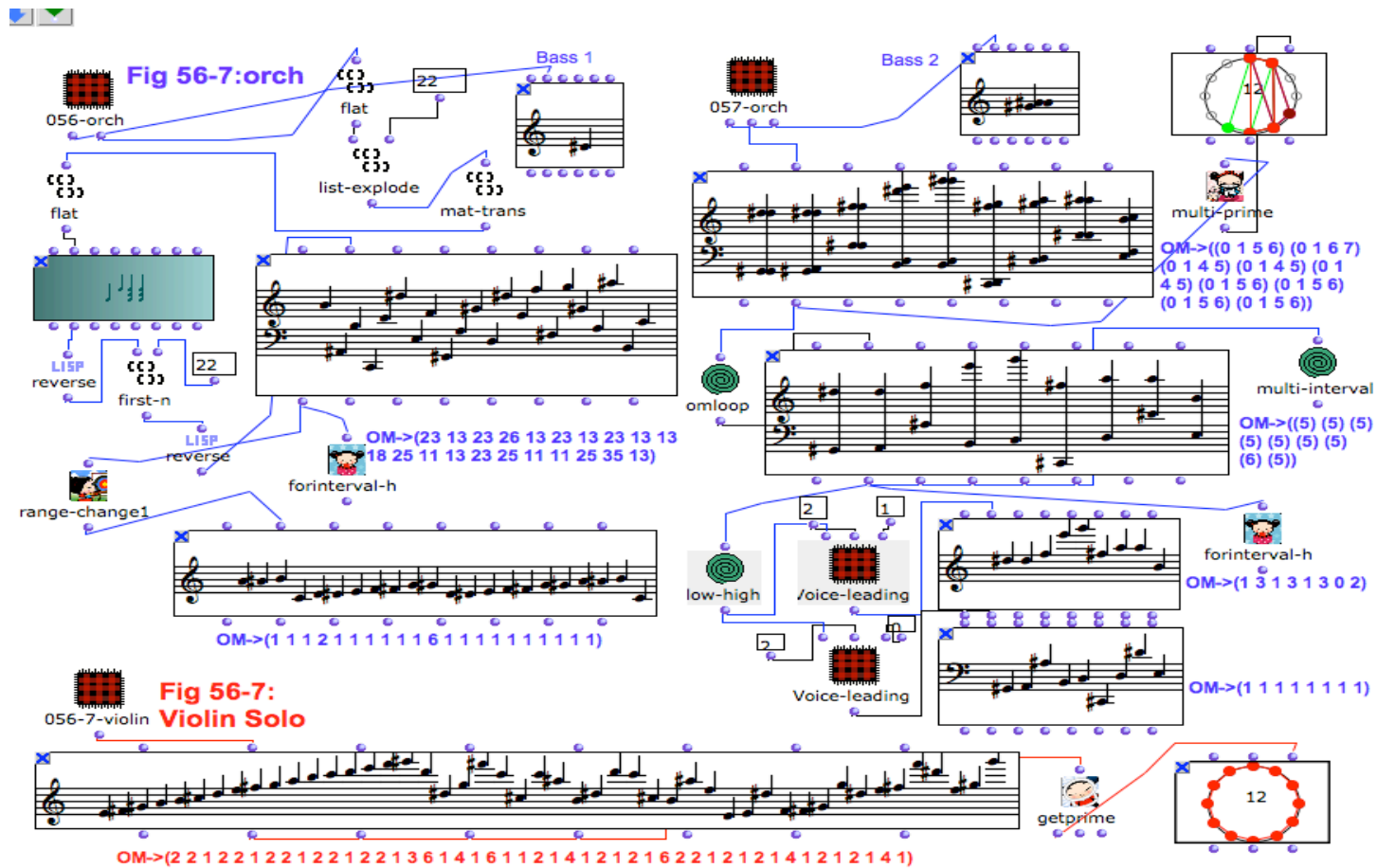


Figure 52
OM analysis of rehearsal 56-7

Figure 53
OM analysis of rehearsal 58

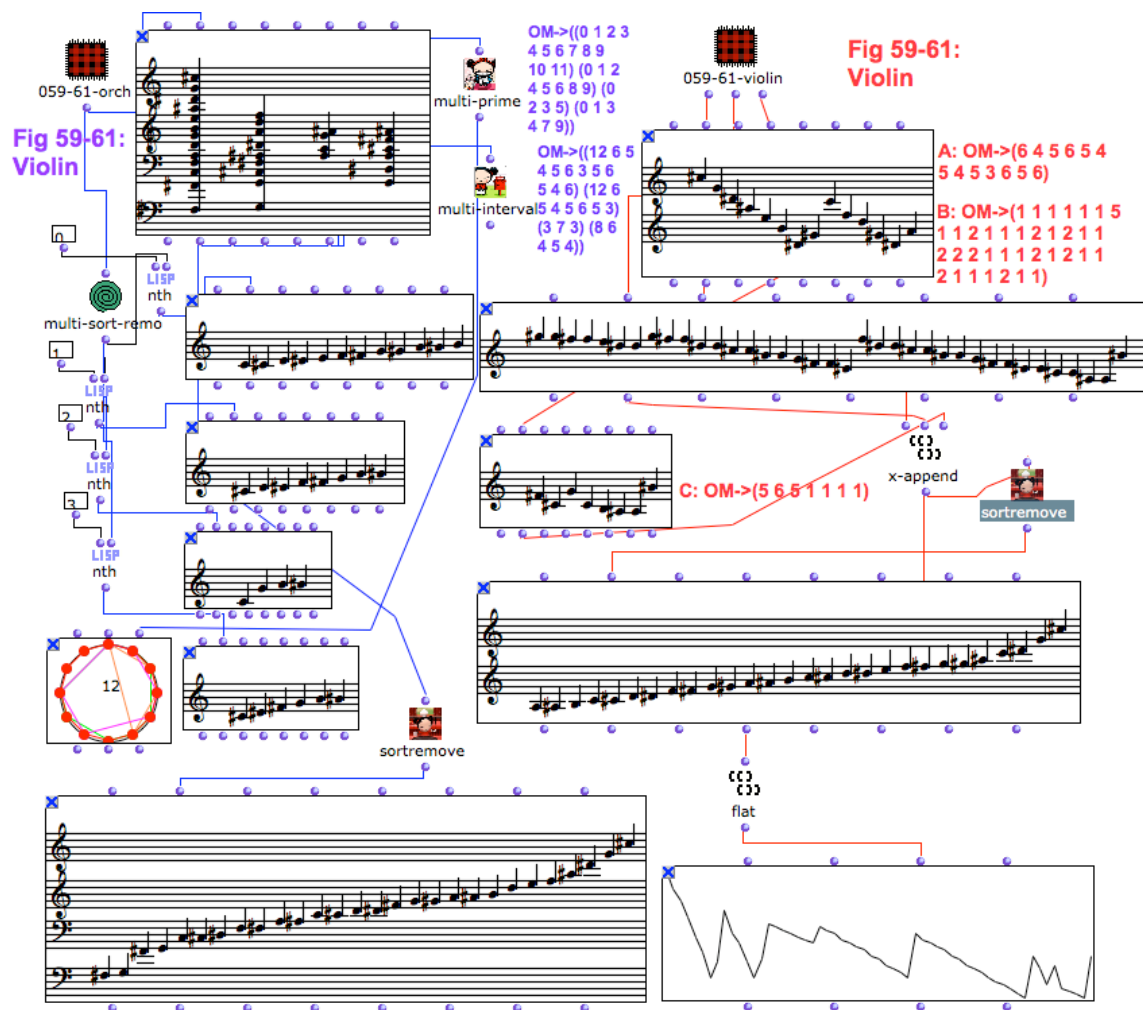


Figure 54
OM analysis of rehearsal 59-61

Up to this point, one should notice that the main focuses of my analysis have been pitch and large-scale temporal structures; rhythm is arguably less significant than the other elements in this piece. Whereas the *Ad Libitum* time structure is featured in the first movement, the second movement is metered with $\frac{3}{4}$ throughout, except at rehearsal 59 where tutti appears. As in Lutosławski's other works, here too he favors certain rhythms such as triplets and repetitions of single notes. The kind of "dance" rhythm associated with notes landing on the weak beats creates energy and pushes the music forward. Examples can be found at places such as the orchestral writing at the

beginning of movement two and from rehearsals 28 to 31, etc. Regarding the textural writing, in addition to the six types that appeared in the first movement and developed in the second movement, new textures are introduced here. These new elements include contrapuntal melodies in the strings at rehearsal number 24 and 32; arpeggiated chords at rehearsals 35, 36, and 58; tutti repeated chords at rehearsals 34, 35, end of 36, 45 until 49; etc.

The graphs in **Figures 55 to 57** illustrate the pitch and time structures of the second movement. Contrary to the graph of the first movement, I divide into three separate graphs according to the three sectional divisions. The first three top layers are the materials of the solo violin, and the rest represent the orchestra. We observe a large number of chord sequences in this movement, of which triads occupy a great portion. One of the features of Lutosławski's late style is combining diatonic and chromatic materials. Among the many passages of the second movement, the melodic line of the solo violin is composed with chromatic materials, whereas the orchestra accompanies with diatonic chords. We also see progressions of these chords that are organized by moving one or two voices in the succeeding chords while more voices sustain, or by expanding or subtracting the number of the notes and spaces in the chord sequence. In contrast to the first movement, the pitch materials of both the solo violin and orchestra are composed with mostly twelve-pitch sets, whereas the pitch materials of the first movement are selective and sometimes complementary in nature.

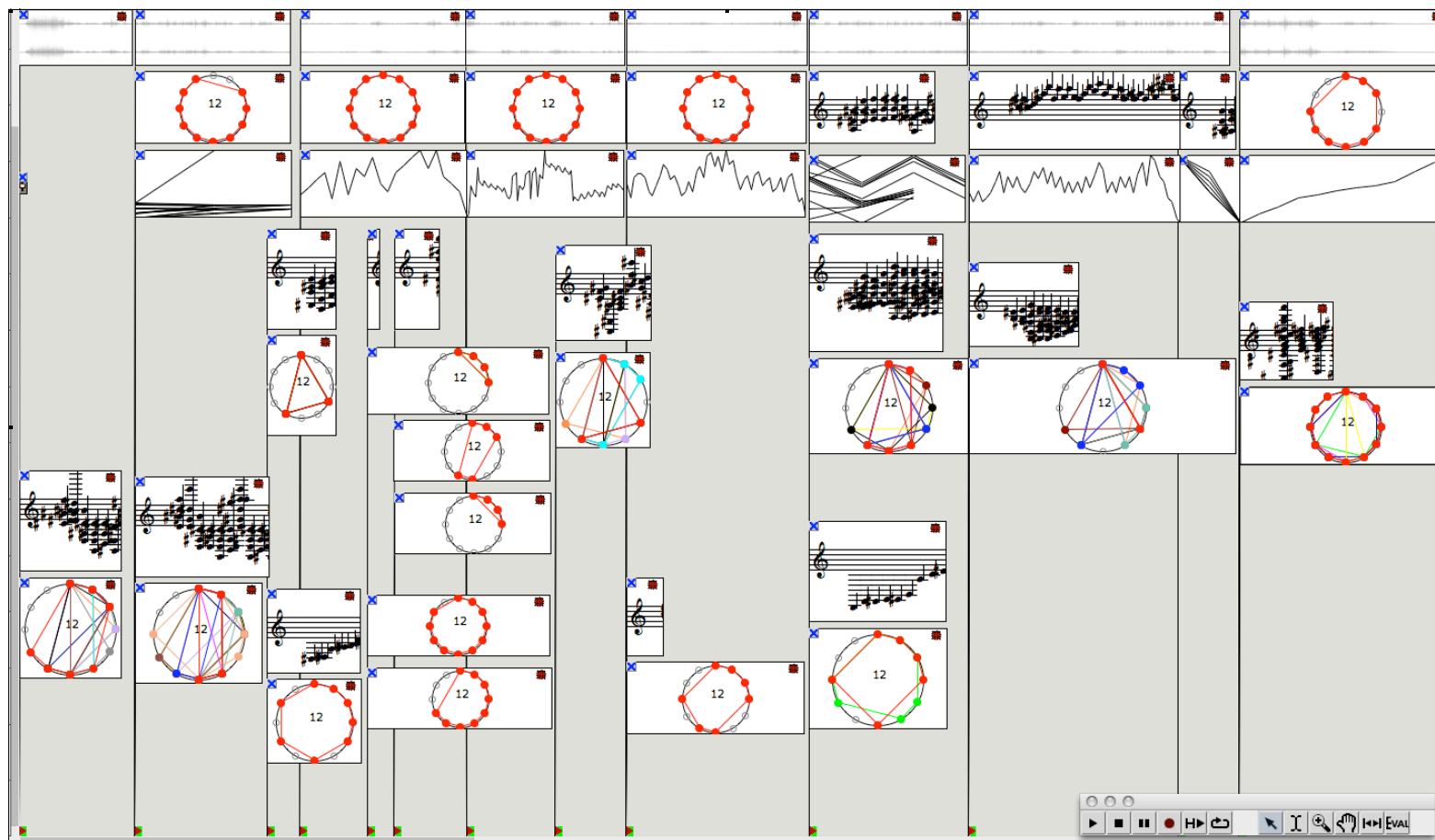


Figure 55
OM analysis of the first section of Movement II (rehearsal 23-36)

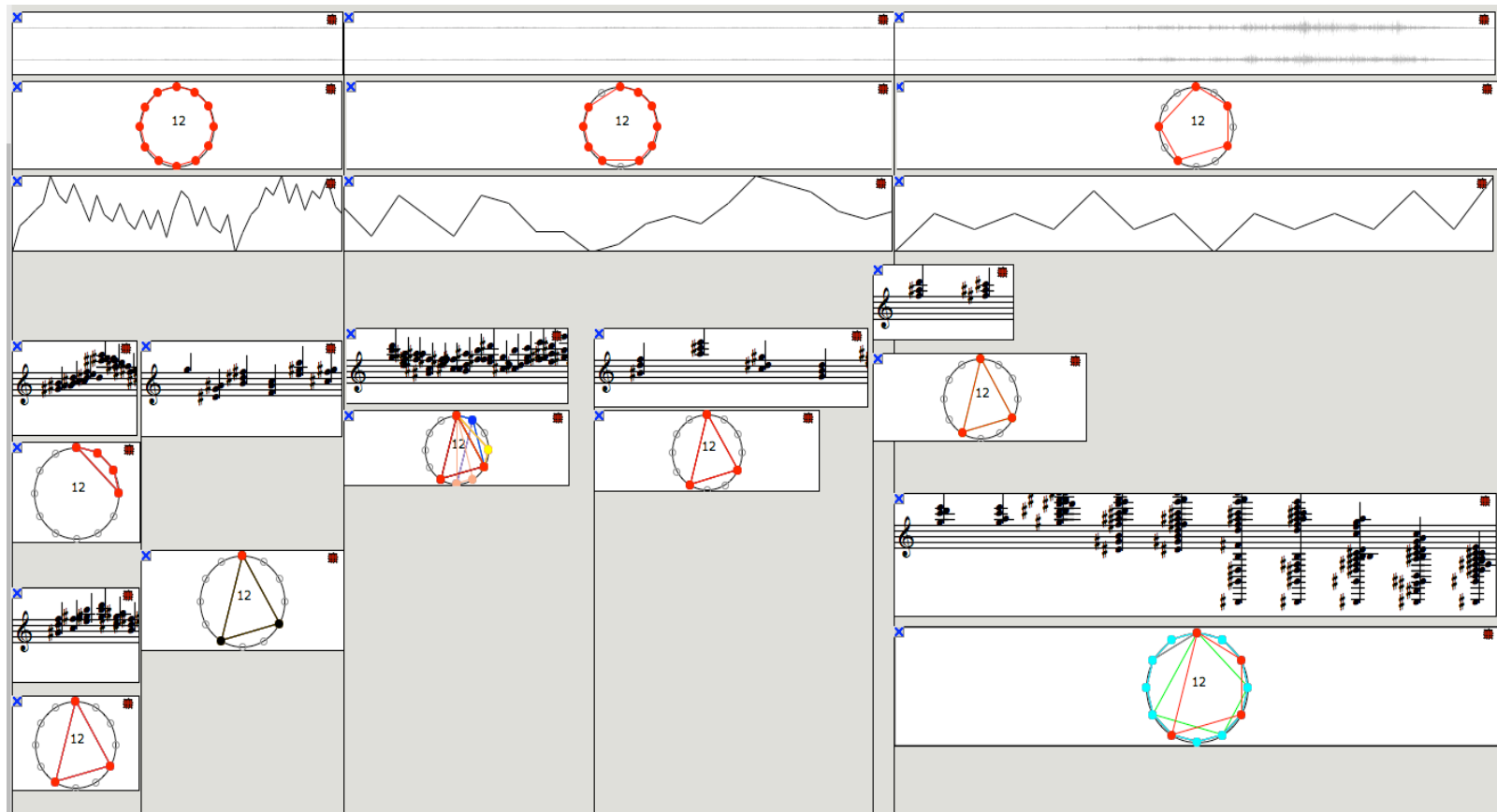


Figure 56
OM analysis of the first section of Movement II (rehearsal 37-49)

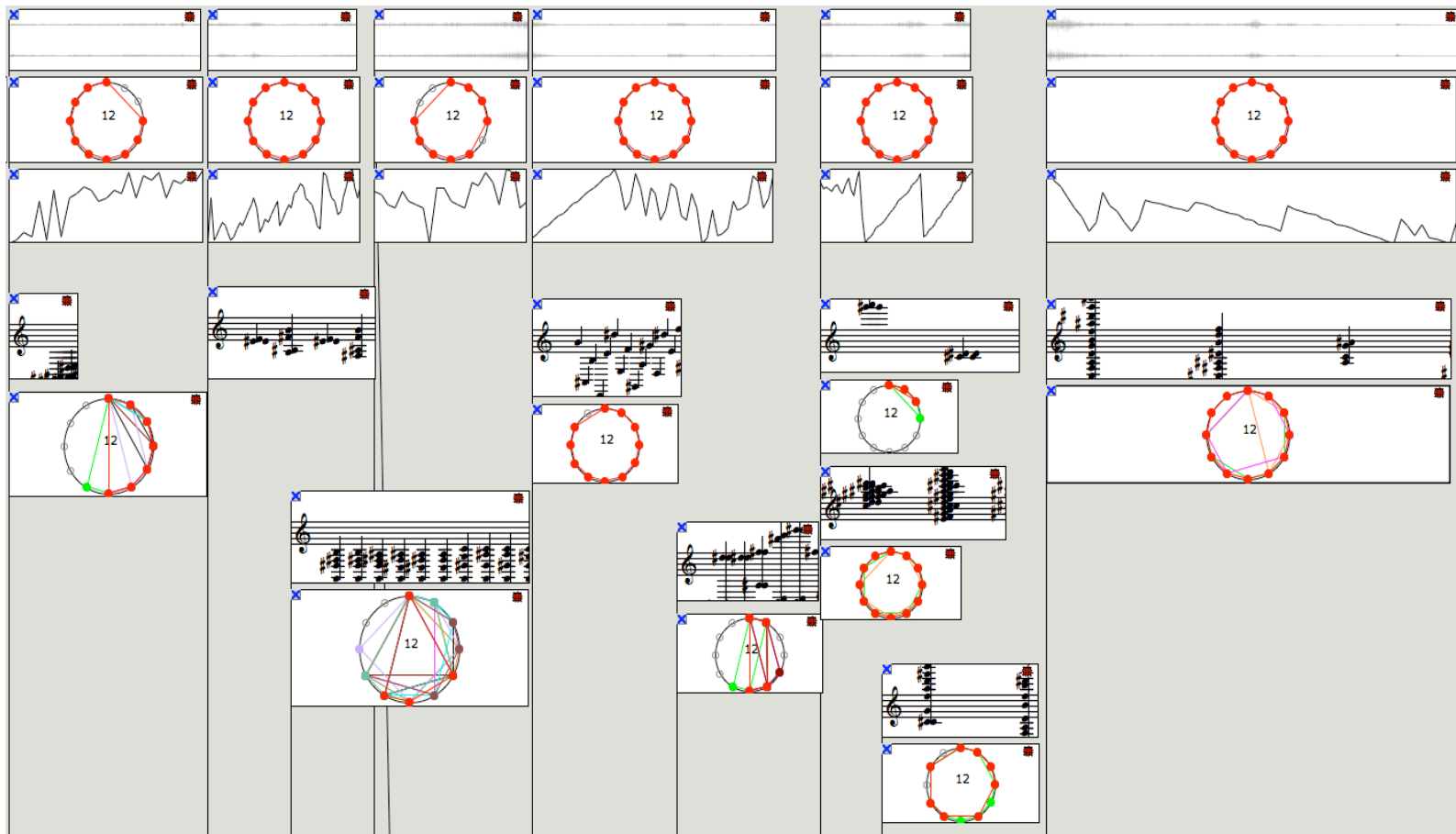


Figure 57
OM analysis of the first section of Movement II (rehearsal 50-61)

The Third Movement *Ad Libitum*

The third movement, like the first movement, is marked “Ad Libitum”. The music can be divided into two sections: the beginning to rehearsal 78 and from rehearsals 79 to 92. However, the movement as a whole sounds fairly unified because recurring motives create what sounds almost like an A+A1 construction.

The first part of the first major section spans the beginning of the movement to rehearsal 65. The solo violin begins on Bb₄, which is a continuation of the top voice of the ending of movement II. The melodic line is marked *molto cantabile*, and each phrase ends on a long note, which I consider important and will talk about in the next paragraph. The three violoncellos are playing aleatory passages within the pitches notated, which gradually change over time; cellos are later replaced by trumpets and vibraphone. Please refer to the OM analysis in **Figure 58**. We can see the pitches in the three chord-sequence editors on the top that are marked a, b and c in red. There are melodic lines separated either by pauses or changes of harmony in the orchestra. Interval classes 1 and 2 are mainly employed, spanning a range from B₃ to C#₅. The three smaller CS editors under them, marked a1, b1, c1, are the pitch materials of these melodic lines. We can see that six (a1), five (b1) and seven (c1) pitches are employed in order to build the melody here. It is obvious to see from these editors that two pitches F and F# are excluded from the melodic line.

We now observe and compare the pitch materials of the orchestra. I divide them into three parts also, and these are marked d, e, and f in blue above the CS editors. We can see from the result in the editors marked d1, e1 and f1 that five, eight and six pitches are employed to build the materials in the orchestra. Now, let us compare the corresponding materials of the solo violin and orchestra, here a1 vs. d1, b1 vs. e1, and c1 vs. f1. We see that no pitches are duplicated in the first comparison, C# and D are duplicated in the second comparison, and G is duplicated in the third

comparison. The two pitches F and F#, which are missing from the melody of the solo violin, are emphasized by the vibraphone, and then both reach G4. The CS editor on the bottom marked g indicates the harmonic progression of both the solo violin and orchestra. We can see a group of chords that generally move toward the middle range from both directions.

The melody played on the solo violin at rehearsal 67 and part of rehearsal 68 features an arpeggiated eleventh-chord, G4-Bb4-Db5-F5-Ab5-B5, which contains interval classes 3 and 4. This is new material that does not appear in the previous music of the solo violin. Then the melodic line gradually climbs from G4 to Ab5 right before rehearsal 70, through interval pairs such as 1+4, 2+5 and 1+2. Only the vibraphone accompanies the melody, which plays from E4 to G through either interval classes 3, 2 and 1. Strings then take over the role to play tremolos on two-note pattern, beginning at D4-C#, then Db4-C4. This reminds us of the passage at the very beginning of this piece. On top of the tremolos, the solo violin first plays a melody that moves by a pattern of interval classes 1-1-1-5-2 then 1-1-1-2-5, and then is immediately followed by the arpeggiated eleventh-chord D#5-F#5-A5-C#6-E6-G6. It is a transposed form of the melody at rehearsals 67-8, which I mentioned before.

The strings, however, begin to play a group of chords, which are transpositions of the previous one and share the same prime form (0 1 3 6 9). We can observe this from the analysis on the bottom left of **Figure 59**. At the last two chords on strings, the solo violin begins to play under a faster tempo and the melodic line features interval classes 3, 1, and 4. Flutes and clarinets join to play the “bundle” material, which begins on B5 then gradually moves downward. We can see from the OM analysis in the CS editor marked F in blue that interval pairs of ic 3+1 are employed here. Slightly before rehearsal 75, the solo violin ends the lyric line with minor-major thirds and minor-major sevenths. Strings play jointly on a seven- note chord slightly

before rehearsal 76. It is quite useful to see the results from object *sortremove* on the very bottom of **Figure 59**, which indicates the pitch materials of the orchestra employing interval pairs 1+3 and then 1+2.

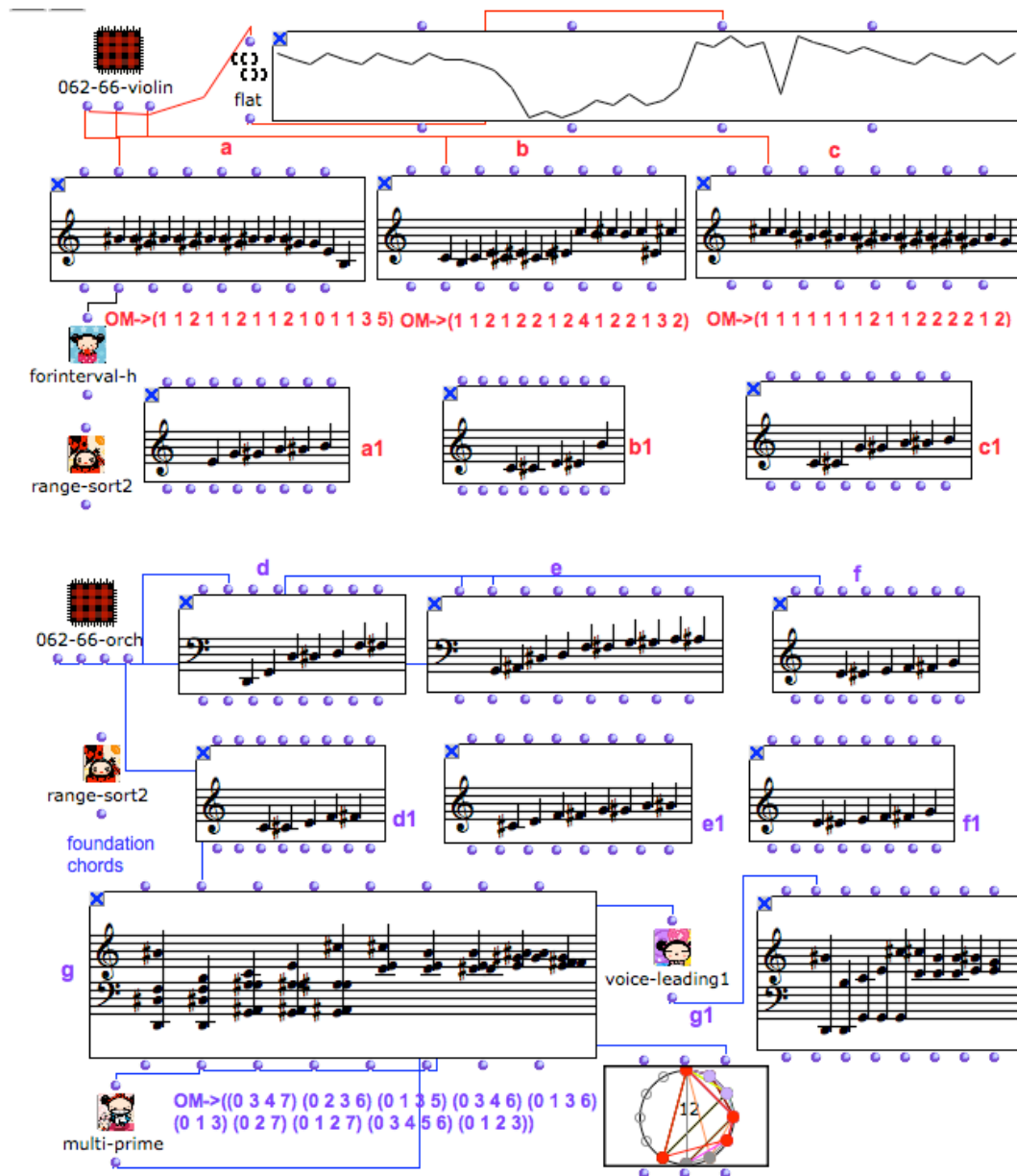


Figure 58
OM analysis of rehearsals from 62 to 66

conclude that the two notes Ab and G played on the solo violin are complementary with the pitch materials of the orchestra. The piano plays a sustained chord at rehearsal 78, which according to the OM analysis (please refer to the CS editor under h) is a symmetrical chord with intervals 3 7 2 1 2 7 3. Note that only four pitches are employed. The violoncellos and double basses also join to play this chord with repeated notes assigned. The solo violin begins on a long note, A3, then plays a group of two-note chords (shown in CS editor under c), which are quite dissonant: most of them are an eleventh apart (ic 1), some are a tenth (ic 2), a seventh (ic 5), a ninth (ic 3), or a thirteenth (ic 1) apart.

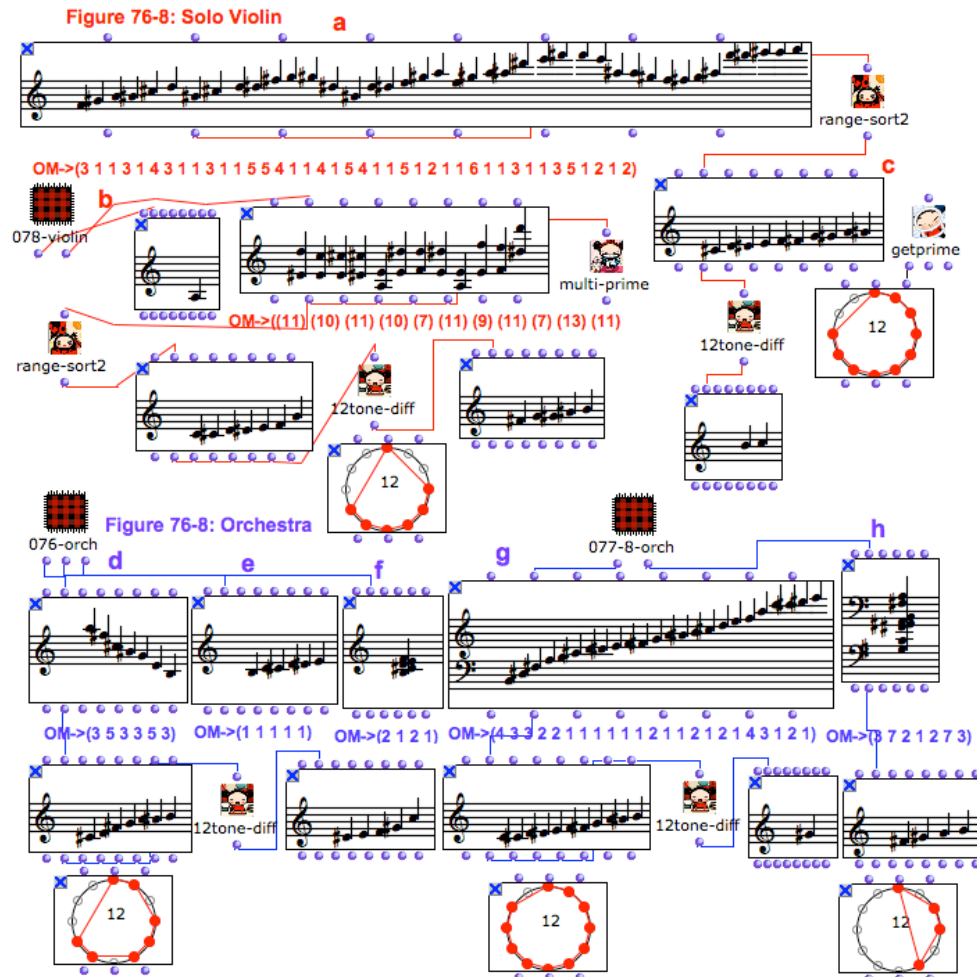


Figure 60
OM analysis of rehearsal 76 to 78

The second section of this movement begins at rehearsal 79. The dynamics of the solo violin suddenly become soft. A passage played in artificial harmonics features mostly the tritones (ic 6), perfect fourths and fifths (ic 5), as well as minor and major seconds (ic 1 and 2). The orchestra responds to each phrase played on the solo violin, creating a kind of dialogue between the two. An important question arises: do they (the pitch materials of the violin and orchestra) share pitches, or are they complementary? We will discover the answer that follows. Let us analyze the first chord played by the orchestra at rehearsal 80, which is symmetrical. You may refer to the result under object *multi-interval*, which yields (3 7 3 19 3 19 3)=(3 7 3 7 3 7 3), after omitting the octaves.

We can also observe the pitch materials of this chord in CS editor under e in blue on the bottom left of **Figure 61**. Eight pitches are employed that are not complementary with the pitch materials of the solo violin before or after. The second chord played by the strings is a four-note chord, a ninth-chord without the fifth (B3-D4-A4-C5). The celesta plays along, which adds additional pitches to the chord in the strings. The pitch materials are shown in the CS editor under f, consisting of nine different pitches, excluding C#, G#, and A#. Since the solo violin continues to play the pattern that consists of only three notes (C, B and Bb), we conclude they are not complementary. The next chord is shown in the CS editor under g, which corresponds to the passage at rehearsal 83. A symmetrical chord (B3-D4-D#-F#) played on the strings blends with the notes played on celesta, which contain seven pitches and are complementary with the pitches played on the solo violin. The last chord of the strings is a cluster of only minor seconds, B3, C4, C#4 and D4. Because D # appears in the celesta, we count it as a five-note chord, which does not share pitches of the solo violin.

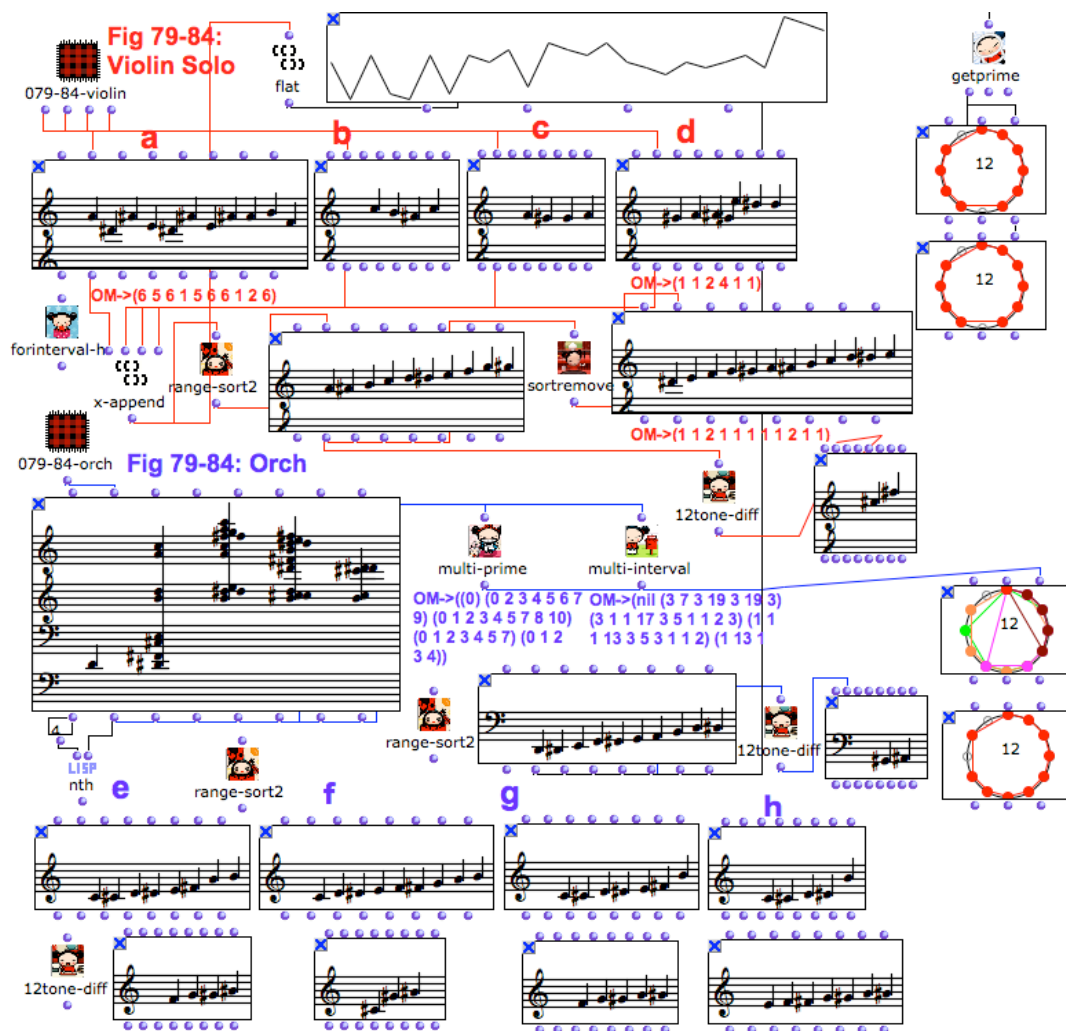


Figure 61
OM analysis of rehearsal 79 to 84

So far, we have not talked about the chain technique in this movement. It is only used in small portions and not so obvious musically, similar to the first movement. At rehearsal 85, the orchestra has already begun playing new material: strings play pizzicatos, and sustained chords are played on woodwinds and brass, while the solo violin is finishing the last phrase from the melody before. We shall pay attention to the pitch materials of both the violin solo and orchestra, because they share the same spaces of time even though the textures of the two are different. Please refer to the OM analysis shown in **Figure 62**. The pitches in CS editor under red

marking a, comprise the melody of the solo violin from rehearsal 85 until the first note of rehearsal 86. We can see that the interval pair 1+2 is employed here. The marking a1 on the right side of the CS editor indicates the five pitches from C# to F by half-steps. The first two chords from rehearsal 85 to the end of rehearsal 87 are played in the strings with pizzicatos and sustained by flute 1 and clarinets, which are indicated in the CS editor under the blue marking e. The first five pitches in the CS editor are marked e2, indicating the pitch materials utilized here. In comparison with the five pitches of a1, they do not share any pitches. It is interesting to note here that the pizzicato melody played on violoncello 1 utilizes four pitches, of which two (G and A#) are the ones missing within the twelve-tone scale. In this sense, all twelve pitches are employed in rehearsal 85, with complementary pitch materials for the solo violin and orchestra.

So now let us discover if the music at rehearsal 86 has the same planning. We can easily observe the five pitches (D, D#, E, F and F#) employed in rehearsal 86 (please refer to b1) and played on the solo violin. Comparing to the five pitches (refer to a1) in rehearsal 85, the pitch materials are transposed minor second up. The pitch materials of the orchestra include the five-note chord played on the strings and the melody played on vibraphone, which consists of six pitches. We can see that all twelve pitches are employed as well if we add up all pitches of the chord and vibraphone line. The third phrase begins at rehearsal 87, strings then change to play the third five-note chord (h) and solo violoncello takes over to play the melody, which consists of five pitches. The solo violin also plays a melody that consists of five pitches (b2). All twelve pitches are employed here. Another five pitches (b3) are employed in the melody of the solo violin. The orchestra accompanies the two passages, each of which employs eight pitches (j2), and the total nine pitches are employed in the orchestra part. We can see that overall eleven pitches are employed,

excluding the pitch E.

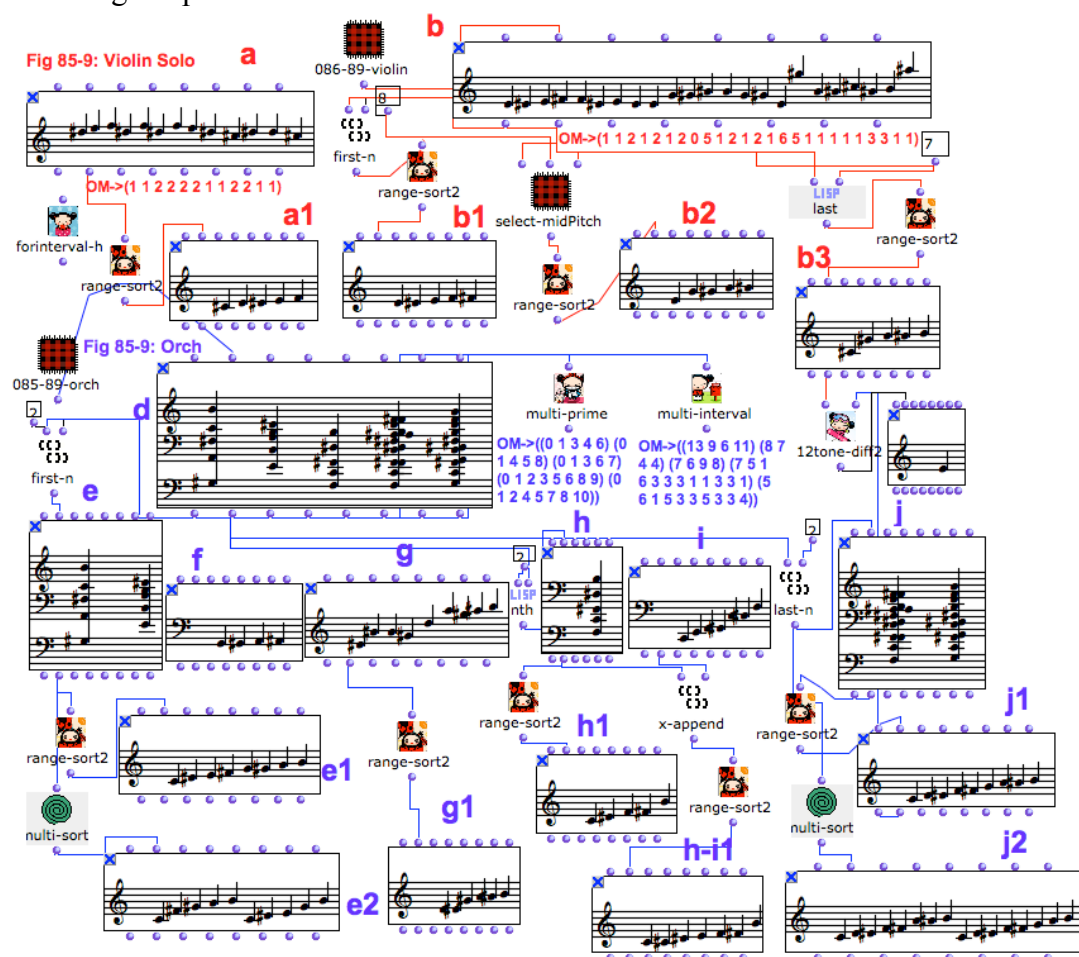


Figure 62

OM analysis of rehearsal 85 to 89

The solo violin again plays a melody that consists of an arpeggiated ninth-eleventh chord at rehearsal 89. We can see from the OM analysis in **Figure 63** that seven pitches are employed to build the melody (CS editor under a is the melodic line and a1 is the result after evaluating object *rang-sort2*). Flute 2 plays a tremolo between G4 and Ab4 to accompany the melody, which is transposed a major second up from the tremolos played on flute 1 at rehearsal 88. Strings and piano continue to play three groups of fast passages, which feature giant chords that move in an upward direction from rehearsal 90 to the first part of rehearsal 92. The CS editor marked e displays the harmony of this passage. In contrast to the orchestra, when the pitch field

spans across several registers, the solo violin plays a melody that consists of only four pitches only minor or major seconds apart. According to the OM analysis shown in CS editors f, g, and h, six, eight and five pitches are employed to build the harmonic progression. The results after evaluating object *12tone-diff2* indicate that none of these places contain twelve pitches; eight pitches excluding (C-C#-E-A) are employed at rehearsal 90 (please refer to bf), ten at rehearsal 91 (bg), and six at the first part of rehearsal 92 (bh). The violins and the solo violin then join together to play a unison melody, which moves from smaller intervals of interval classes 3 or 4, to ic. 6 with an emphasized F#. The ending (d) finishes with the solo violin playing alone, a melody built of three interval classes 1, 6 and 5. The movement ends at F#4. Only three pitches are employed, F, F# and B, which are shown in d1.

The third movement contains some of the most haunting passages of *Chain 2*. A continuation of the first movement, the solo violin holds its leading role throughout, while specific groups of instruments accompany the melody with light orchestration. Similar types of textures of the first movement are retained with new elements, such as harmonics in the string section at rehearsals 80 to 84, the violin solo accompanying of the orchestra at rehearsals 85 to 87, as well as a brand-new feature that is introduced at the end of this movement: unisons of strings and solo violin (Cantilena type 2)³⁹.

Through the graph shown in **Figure 64** that is the overview of the third movement, we observe a combination of features previously used in both the first and second movement. Slightly more complex than the first movement but simpler than the second regarding pitch organization, some passages are thoughtfully composed with regard to the complementary relationship of the pitch materials. One example can be found towards the end of the movement from rehearsal number 85 to 89, corresponding to the area below the second-to-last sound box of the second layer.

³⁹ Please refer to page 33-4.

Within this area, four small boxes of the third layer represent the four micro sections of the solo violin, while four smaller boxes of the fifth layer correspond to the orchestral pitch materials. It is fairly clear to observe that each of the pitch materials of the solo violin is complementary with the orchestral materials of each box below. In addition to that, the composition of the solo violin is a combination of melodies and chords, although the former are largely employed and the latter is set right in the middle of the movement. Such lyrical writing gives expectations that prepare the listener well for the final movement.

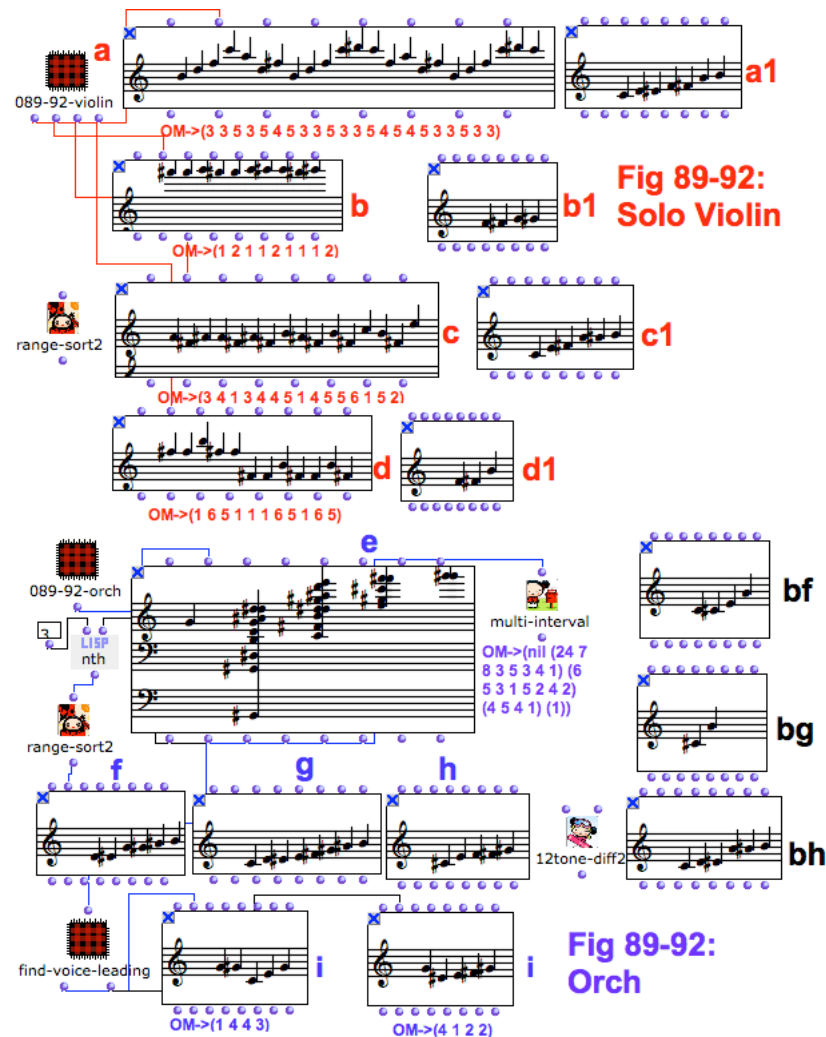


Figure 63
OM analysis of rehearsal 89 to 92

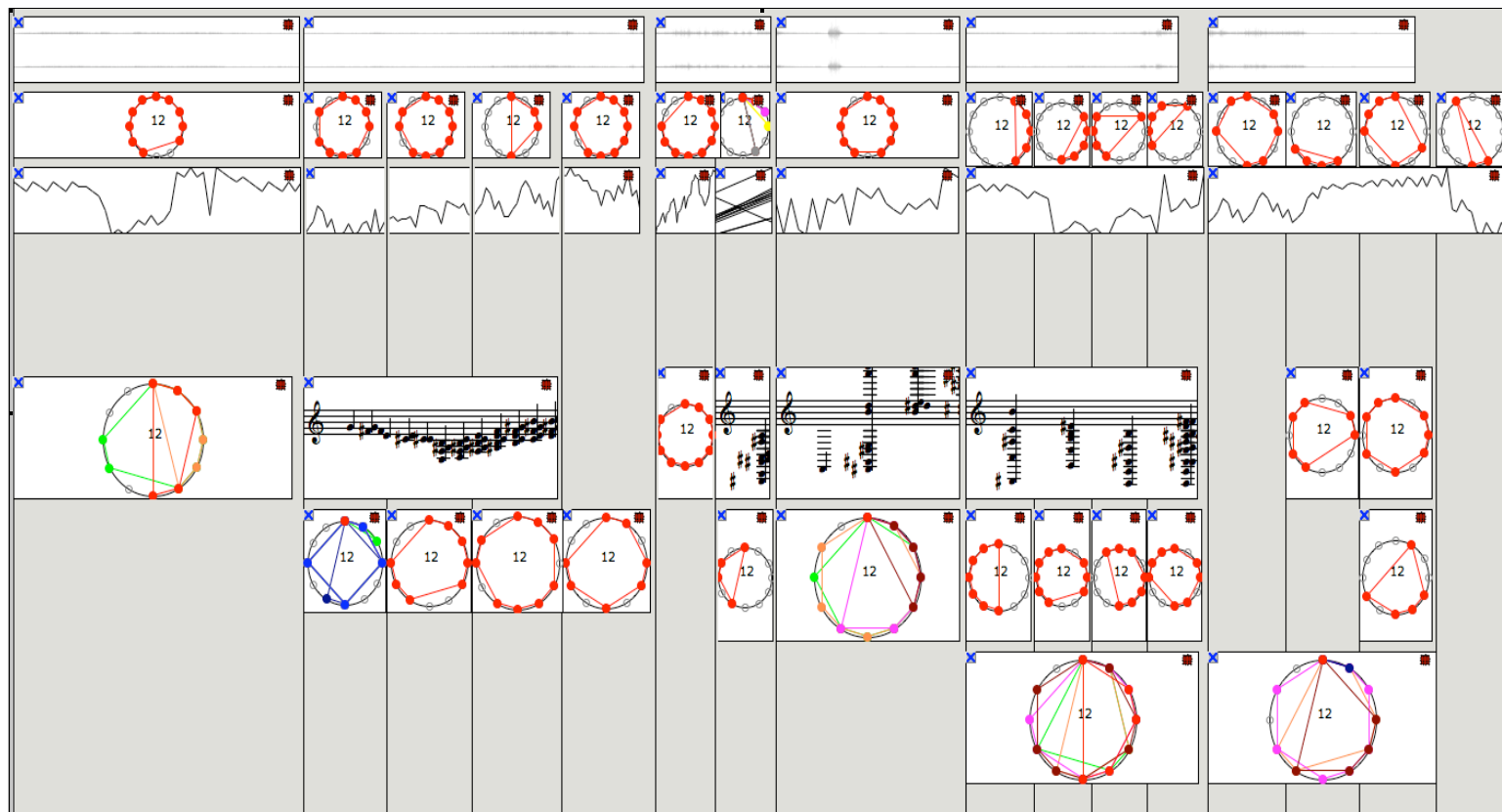


Figure 64
OM analysis of *Chain 2* Movement III

The Fourth Movement *A Battuta*

We may divide the last movement into four sections. The first section is from the beginning of this movement until rehearsal 100; the second section is from rehearsal 101 to 107; the third is from rehearsal 108 to 115; and the last is from rehearsal 116 until the end. The chain form of this movement often immediately follows with the return of regular sections that begins or ends together. Through **Figure 65**, we observe that the *chain* moments occur at the beginning and middle parts followed by a tutti of the orchestra such as rehearsals 100, 107, 115, and finally 122–125. We may now analyze each micro section in the OM environment.

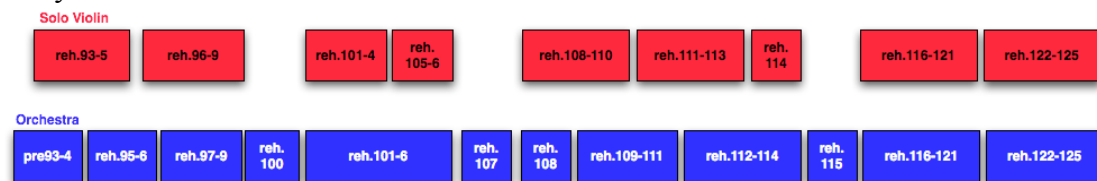


Figure 65
Illustration of *Chain* form in Movement IV

The strings begin the fourth movement by playing a short vivid passage with an extreme dynamic change from *ff* to *p*. The woodwinds then respond with similar textures that are soon taken over by the strings with a longer phrase. Two giant chords are built for these passages discussed above, which are the first and third chords shown in the CS editor under c in **Figure 66**. With OM analysis tools, we can see that eight pitches are employed to build the first chord (refer to c1), and twelve pitches are employed to build the third chord. If we look closely at the third chord, we observe that two types of four-note chords of Rae's chart are employed on the top of this chord, which are B ic 3-3-4 and K ic 5-3-3= chords. The violins then play tremolos moving slowly from F#4 to B4 by steps. At rehearsal 93, the solo violin enters and plays short phrases that contain mostly interval classes 1 and 2 (shown in a). We can see that eight pitches are employed (a1). Note that the four pitches (F#-G-G#-A) missing (shown in a2) from the aggregate are actually played on the strings, which

accompany the melody below (refer to d in blue). The English horn plays a short melody that leads to rehearsal 94 and adds four more pitches (D-D#-E-F) to the pitch materials of the orchestra. Flutes, clarinets and bassoons join together playing vivid short passages that are arpeggios of a sequence of three-note chords (shown in e). We see that two types of chords are employed here, whose primes are (0 3 7) triads, and (0 2 5). The pitches in e1 indicate that all twelve pitches are employed in this group of chords. On the other hand, the solo violin begins to play an uninterrupted passage, which moves by only three interval classes 1, 3 and 4. The result of the pitch materials in CS editor b1 indicates to us that all twelve pitches are employed. To be noticed, the violoncello takes over from the English horn to play the accompanied melody at rehearsal 94, which contains nine pitches and serves as the beginning of a counterpart passage. This polyphonic texture is a new material that has not appeared before.

The oboe begins to play the third part of the contrapuntal line at rehearsal 95 after the violas began slightly earlier playing the second line. The three parts build the counterpoint until rehearsal 96, when the violas and violoncellos join to play together and oboe plays solo. The CS editor under g in **Figure 67** indicates that all twelve pitches are employed in this passage. The solo violin on the other hand plays on a melody (a), which consists of mostly interval class 1 and 2 in short phrases or repeated patterns. Other intervals such as ic 3, 5 and 6 are used to connect these phrases. The result shown in a1 indicates that nine pitches are employed, excluding G#, A and A#, of which A and G# are interestingly used in the two-note chord at rehearsal 96. It is similar to the arrangement for the pitch materials of the orchestra, of which E and F do not appear until the last phrase played on oboe in rehearsal 96.

At rehearsal 97, the woodwinds begin to play vivid passages that are based on arpeggiated three-note chords. This texture first appears in rehearsal 94. A sequence of chords shown in h indicates the harmony, and we observe that major triads (prime 0 3

7) are the main contents, which lead to the last symmetrical chord with five notes. We observe that ten pitches are employed for these chords, which exclude A and A#(Bb). We observe that the second contrapuntal movement begins at rehearsal 97 when violas play the theme and later are responded to by violins and oboe at rehearsal 99. It complements the twelve notes with the emphasis of these two pitches. The melody of the solo violin at rehearsal 99 (shown in f) begins to move using an interval pair of 1+3, then finishes with two other pairs of 1+2 and 1+5. All twelve notes are employed in this passage.

The passage at rehearsal 100 is probably the most challenging place for analysis so far. The harmonic structure can be divided into two layers, of which the top layer contains a sequence of five-note chords and the bottom layer contains a sequence of four-note chords. Let us observe the bottom layers first because it is more obvious. Please refer to CS marked c in **Figure 68**. We can see from the analysis of the prime forms that four types of four-note chords are employed: (0 1 4 7), (0 3 5 6), (0 3 6 7), and (0 1 4 5). Oboes, clarinets, chimes, and celesta are the main forces playing these chords. The chords of the top layer are quite narrow, most of which contain one or several minor seconds. Also, four types of five-note chords are employed, which we can see from the analysis of CS editor marked b: (0 3 6 7 8), (0 1 2 3 6), (0 1 2 5 8), (0 3 4 5 8). It is clear to see that none of these chords when combined together are symmetrical.

Instruments of the orchestra join together to play a giant chord at rehearsal 101 (please refer to the chord editor marked d). According to the analysis shown in d1, it is a nine-note chord excluding D#, A and C. The two bassoons play a duet right after the large chord, of which the melody on bassoon 1 is built with interval pairs 1+3. The piano then begins to play the first five-note chord of a sequence of chords, each of which has a three grace-note phrase attached to it. These chords are shown in h; many

of them are symmetrically built, which can be seen through the object *multi-interval*. Eleven pitches, excluding a, are employed in the sequence of chords. The two oboes take over the role of the duet, which is played on bassoons earlier. They play two short phrases on a downward scale of six pitches (Bb4-A4-Ab4-G4-D4-Db4-C4). The bassoons continue the duet with a melody that consists of two phrases of nine pitches (shown in f and g). The melodies played on bassoon 1 are built on an interval pair of 3+1. The solo violin begins late in the fourth measure of rehearsal 101, using groups of three-note phrases. The first two notes are always neighboring notes of either minor or major seconds, the third notes mostly leap to higher pitch through various intervals up to a major seventh. Ten pitches are employed, excluding C# and D, which we can see from a1 and a2 in **Figure 68**.

Strings suddenly play soft dynamics at rehearsal 102 while the solo violin continues in a three-note pattern. Clarinet 1 joins to accompany the melody with the three-note pattern as well. But instead of utilizing two interval classes, it plays on either interval classes 5 or 2. The CS editor marked d in **Figure 69** indicates the harmony from rehearsal 102 until the first chord at rehearsal 104. Here, we observe that two types of chords are built : the first, third, fourth, sixth and eighth chords have major-minor triads on the top. They have either a perfect fourth on the bottom or a tritone in the middle.

The solo violin begins to play new materials beginning in rehearsal 103. In the analysis under b, we observe that interval classes 1 and 5 are employed for building this melody. Two trumpets continue with the duet material, which was played on two bassoons before: interval pairs of 1+3 are still applied here. The CS editor f displays the first passage of this duet. The bass clarinet plays on a melody that is built on another pair of intervals 1+4, as we observe in g. The strings and the piano join together playing a group of symmetrical chords shown in e. The triplet grace notes

played on the piano are separated by either a thirteenth or a minor second, except the second to last chord of e, where the bottom to middle notes are a perfect fourth apart. The solo violin has already begun a new section from rehearsal 105, as shown in c, the melody of which moves mostly in interval classes 1 and 3, occasionally 4 and 2. We can see that the harmony becomes more complex and consists of six-note chords when the solo violin moves towards the high register at rehearsal 106. The chords at the beginning and end are built symmetrically, as shown in h.

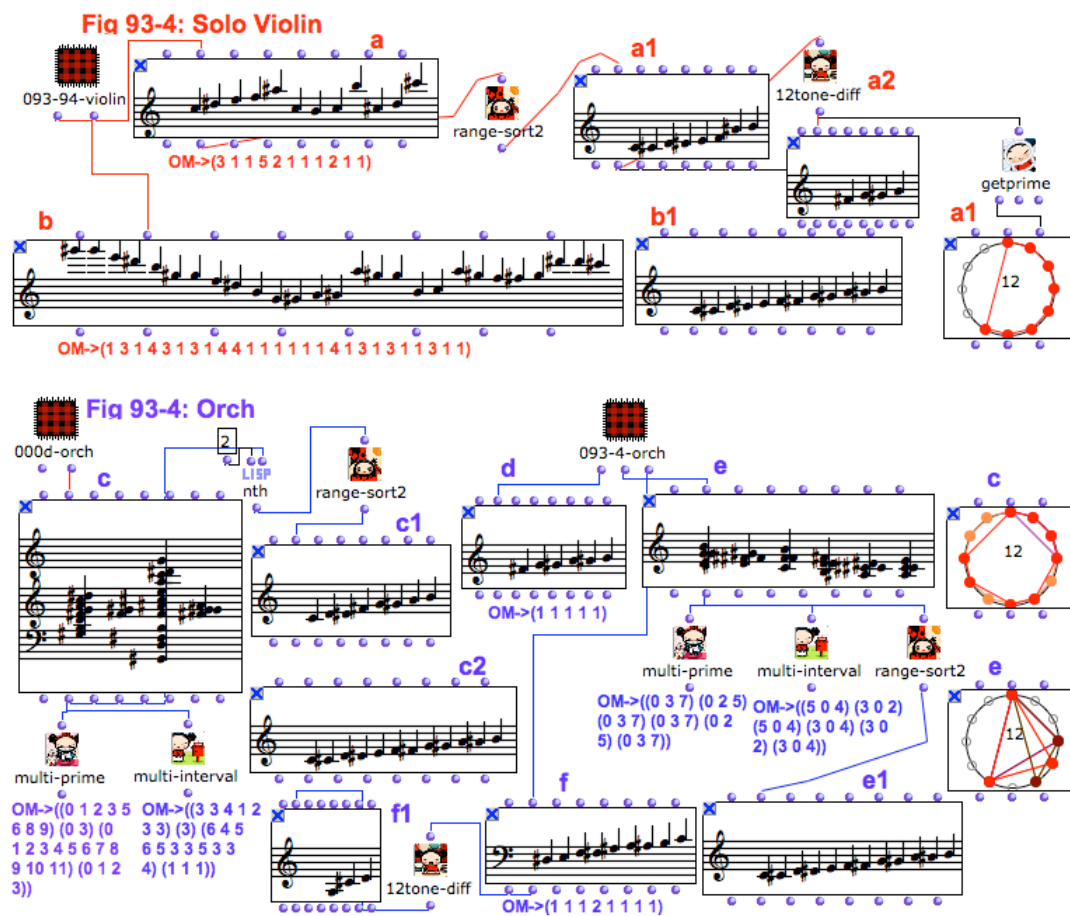


Figure 66
OM analysis of rehearsal 93-4

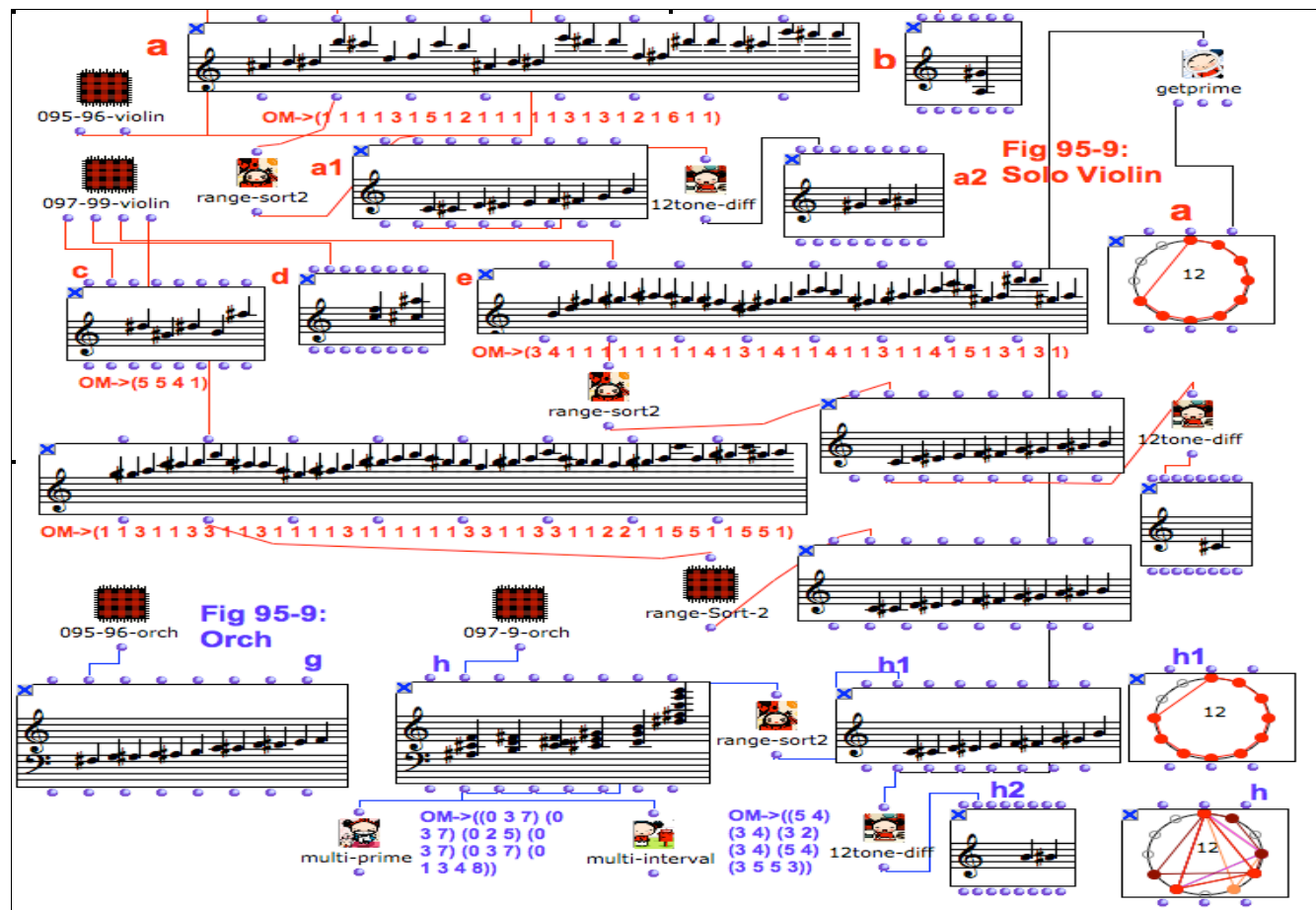


Figure 67
OM analysis of rehearsal 95-9

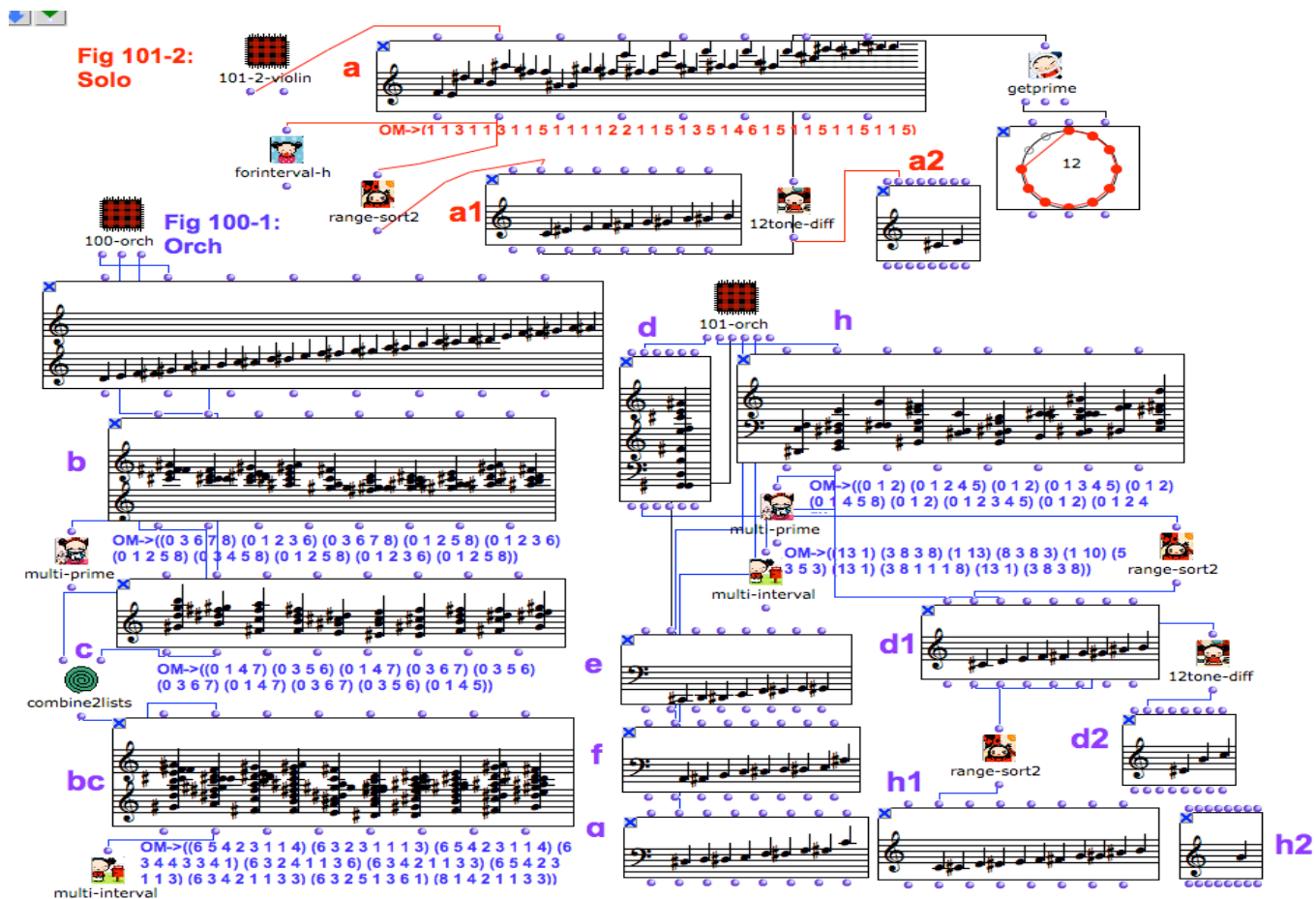


Figure 68
OM analysis of rehearsal 100-102

Fia 102-6: Violin Solo

102-3-violin **a** x-append 104-5-violin **b** 105-6-violin **c**

OM- \rightarrow (1 2 2 1 1 5 1 3 5 1 2 6 1 5 1 1 5 1 1 5 1 1 5)

OM- \rightarrow (1 1 1 5 1 5 1 1 1 1 4 1 1)

OM- \rightarrow (3 1 3 4 3 1 3 3 2 3 1 1 0 3 1 3 4 3 1 3 1 3 1 1 1 1)

range-sort2 **a1** **b1** **b2**

Fia 102-6: Orch

102-3-orch **d** 104-5-orch **e** 106-orch **h**

multi-interval OM- \rightarrow ((5 11 4 3) (2 7 2 7) (5 9 4) 3) (6 4 5) (2 7) (5 6 4 5) (4 3) (2 9 4 5))

multi-prime OM- \rightarrow ((0 1 4 7 8) (0 3 5 6 8) (0 2 5 6 9) (0 2 5 8) (0 3 5) (0 1 4 6 9) (0 4 7) (0 3 4 6 7))

multi-interval OM- \rightarrow ((f 13) (8 3 8 3) (13 1) (3 8 3 8) (13 1) (3 8 3 8) (5 13) (8 3 8 3))

multi-prime OM- \rightarrow ((0 1 2) (0 1 3 4 5) (0 1 2) (0 1 2 4 5) (0 1 2) (0 1 2 4 5) (0 5 6) (0 1 3 4 5))

multi-interval OM- \rightarrow ((6 3 8 3 8) (3 4 5 2 7) (2 4 3 7 2) (4 5 6 2 13 5) (5 3 5 5 3 5))

multi-prime OM- \rightarrow ((0 1 2 4 5 8) (0 2 5 7 8) (0 2 4 6 9) (0 1 2 3 6 8 9) (0 1 2 5 6 8 9))

for interval-h OM- \rightarrow (4 1 1 1 4 1 1 4 1)

f **g**

Figure 69
OM analysis of rehearsal 102-106

The music at rehearsal 107 is the second place in the fourth movement where there is no violin solo (first was at rehearsal 100). I consider it the development of the preludes, which appear at the beginning of each movement. We can see in **Figure 70** under a that ten chords are employed here, and then all of them are nine-note chords. The results under the patch *multi-prime* indicate that chords 1, 2, 3, 5, 9 share the same prime form of (0 1 2 3 4 6 7 9 10), chords 4, 6, 8 share the same prime of (0 1 2 4 5 6 7 9 10), and chord 7 has its own prime form, which is (0 1 3 4 5 6 7 8 10). The pitch materials of the woodwinds, brass and piano are shown in CS editors that are marked from b1 to b8. We observe from the OM analysis that the prime forms of b1 to b4 share with the two numerous types of nine-note chords in a: for instance, b1, b2, b3 has the prime form (0 1 2 3 4 6 7 9 10), b3 has the prime form (0 1 2 4 5 6 7 9 10). Now, the most curious question is whether the chords in a are complementary with the pitches in b1 to b8. The green patch *compare2lists* aims to find the answer, which adds up each of the chords in a, and the corresponding pitches in b. For instance, it compares chord 1 of a with b1, chord 2 of a with b2...and so forth, and then it compares each a+b within the aggregate to find out which pitches are missing. The results are shown in editor ab1, we see that only the chords of the first group, a1 vs. b1, are complementary.

After the group of large chords, the harmony of the orchestra suddenly changes and moves to the low register at rehearsal 108. The contrast between wide and narrow planning of the space, and between high and low registers, creates drama and adds intensity to the music. Timpani, piano, and double basses join to play the three-note pattern (G#-A-A#) within two octaves. The solo violin enters late, playing a melody on an upward motion from G3 to C#5. We can see from the OM analysis in **Figure 71** that the nine pitches employed for the melody of the solo violin (a1) are complementary with the three pitches employed in the orchestra (f1). Different

instruments of the woodwinds and brass enter at different points to create a chord, and harmony begins from one pitch to an enlarged chord and then diminishes to another note (s). For instance, the first chord at rehearsal 109 begins on D4, and other pitches are introduced through the entrance of new instruments or changes of the repeated notes. The passage finishes on B2, played by the second trombone. Chord 2 adopts a similar process, but instead of moving from high to low registers, it goes in the opposite direction. We can observe these chords in CS editor f in **Figure 71**.

The OM analysis results indicate to us that the four chords employed in rehearsals 108 to 109 are symmetrically structured. We have already discovered that the first chord of the four is complementary with the pitches of the melody. Let us find out if it is the case for the rest of the three chords. The solo violin plays a short phrase at rehearsal 109, which consists of six pitches shown in b1. When we compare b1 with f2. We find out they are not complementary, since the two pitches C# and D# are missing. If we continue to compare the next melody of the solo violin (c1) with the pitch materials of the orchestra (f3), we discover that the very same two pitches C# and D# are missing. This implies that ten fixed pitches are employed for creating these chords. The last chord of the four should be considered part of the music of the next rehearsal number because the textures of the upward stepwise “bundles” continue until rehearsal 110. All twelve pitches are employed, of which eight pitches from C#4 to Ab4 are used for the passages in the last two measures of rehearsal 109 (shown in f4). Another eight pitches from Eb5 that move downward by steps to A4 are employed at the beginning of rehearsal 110.

Figure 70
OM analysis of rehearsal 107

Fig 108-110: Violin Solo

a 108-9-violin OM->(4 2 2 2 1 5 5 2 2 2 1 2 1 5 5 5 11 14 4 2 2 2 6 5 2 2 12 11)

b OM->(4 2 6 5 2 2 5 6 2 2 1 11)

c range-sort2 OM->(3 2 2 2 1 4 5 2 2 1 11)

d 110-violin OM->((11) (11) (11))

e OM->((4) (11) (4) (4) (11) (13) (7))

a1 **a2** 12tone-diff

b1 **c1**

f 108-9-orch

f1 range-sort2

f2

f3 **f4**

multi-prime OM->((0 1 2)
(0 1 2 3 5 7)
(0 1 2 3 5 7 8)
(0 1 2 3 4 5 6 7))

multi-interval OM->((1 1 10 1 1)
(1 4 1 4 1 4) (4
1 4 1 4 1) (1 1 1
1 1 1 1))

g 110-orch

multi-interval OM->((1 1 1 1 1 1) (5 4 4 1
1 4 3 4) (1 4 6 5 3 3 4)
(2 2 1 1 3 4 3 4) (5 3 3 5 3
3 4) (5 4 4 3 3 4 4 4 7) (7
4 6 5 4 7 4 3 4 7 3))

diff2

g1 voice-leading1 multi-prime OM->((0 1 2 3 4 5 6)
(0 1 2 3 4 5 6 8 9)
(0 1 2 3 4 6 7 9) (0
1 2 3 4 5 6 8) (0 1 2
4 5 7 8 10) (0 1 2 3
4 5 6 8 10) (0 1 2 3
4 5 6 7 8 9 10 11))

h

g2 OM->(3 4 1 4 0 4)
OM->(0 5 2 5 0 0)

Figure 71
OM analysis of rehearsal 108-110

Before we continue with the analysis of the materials of the orchestra, let us take a moment to observe the materials of the solo violin. We have already spoken about the melodic lines of rehearsal 108 to 109, but we have not yet mentioned the two-note chords that are placed at the end of each phrase. I include them together in d of **Figure 71**, where we can see that two notes of each chord are an eleventh apart. From the last measure of rehearsal 109, only two-note chords are presented. As shown in e, other types of the two-note chords such as major thirds, thirteenth, and sevenths are employed. A total of ten pitches, excluding D# and E are employed as shown in e1 and e2. Now, let us observe the complex materials of the orchestra in rehearsal 110. They are a development of the similar texture at rehearsal 109 but much more complex. I have displayed the harmony as the chord progression in g of **Figure 71**. One might ask, how do I decide the chord, since the music of this part appears to be a lot of moving notes. Here is what I do in determining the harmony: first, I separate each phrase whenever there is a rest, which also coincides as the repeated dynamic pattern of *pp* crescendo to *mfp*. The second step is to determine the notes of the chord, instead of including all of the notated pitches, I choose only the “important” ones. It is clear that some notes are used only as passing or neighboring notes, which should not be considered in the chords. The repeated notes, especially those marked *mf*, are included in the harmony.

The chords indicated in g of **Figure 71** represent the harmony of the orchestra at rehearsal 110. The first chord should be separated from the chord progression since it material that continues from the previous passage. Eight, nine and twelve-note chords are employed, of which the last chord consists of all twelve pitches. We could not really tell from the interval analysis of the results of *multi-interval* (that is on the right side of g) what rules are based to build these chords. However, we observe that interval classes 3, 4 and 5 are favored more than other intervals. If we observe the

melodic lines in general, we see that many of the “bundle” materials are based on different types of seventh or ninth chords. As these chords usually begin from a narrow interval that is enlarged to wider intervals vertically, I consider the top notes of the first note of each phrase as the leading and important pitch. The notes in h display the voice leading lines of the passages, which moves from C4 to G#5 through interval classes, 1, 3, 4, and 5. The group of two-note chords in g2 represents the voice leading lines of the high and low voices of the chords in g, of which the top voice moves through ic 1, 3, and 4 and the bass through ic 2 and 5.

It is interesting that rehearsal 111 is marked in between the continuous materials of both the solo violin and orchestra. One would guess that it is the point where twelve-note harmony appears, even though it has already begun on the third beat of the last measure. We now move on to the next passage begun in the third measure of rehearsal 111. Here, clarinets and bassoons play the repeated patterns, with each voice is composed of four notes. The trumpet and trombone each play a sustained note, a major seventh apart. The last measure of rehearsal 111 features another short moment of the bundle texture, which has appeared at the beginning of this rehearsal. Then at rehearsal 112, the group of two clarinets and bassoons returns, and each of them plays another four-note pattern, while the trumpet and trombone move on to another sustained major seventh. I have indicated the harmony of rehearsals 111-112 in **Figure 65** under c. It is interesting to see that the first and third chords are twelve-note chords, whereas the second and fourth are symmetrically structured six-note chords. Now, let us observe the materials of the solo violin, which is shown in a in this figure. The structure of the melody is clearly based on interval classes 1 and 4. If we divide the melody into two parts, according to the harmonic changes of the orchestra, we find that six pitches are employed in each of the parts, and that they are complementary with the pitch materials of the orchestra. For instance, the six pitches

employed at the third measure of rehearsal 111 (a1) of the orchestra are complementary with the six pitches of the violin solo (c1); the six pitches employed for the orchestra at rehearsal 112 (c2) are complementary with the six pitches employed for the solo violin of the first two measures of rehearsal 112 (a2).

The solo violin continues playing groups of two-note chords, which can be grouped into three-note chords since they overlap the middle notes. As shown in b in **Figure 72**, these chords move toward C6 in the high voice, harsh and intense. Meanwhile, the orchestra begins new material that consists of two layers of different textures at rehearsal 113: the piano and xylophone play several chords that jump between the high and low registers. The woodwind instruments take turns decorating these chords by adding new passing and neighboring pitches with vivid bundle textures. There are seven chords that are played on the piano, of which the first, third, fifth and seventh are doubled by xylophone (shown in d). The odd-numbered four-note chords are built symmetrically, as we observe the OM analysis result of the multi-interval object. The materials in the editors from d1 to d6 do not just come from d, which is from the second outlet of the patch named *113-orch*. The data from the first outlet contains not only the chords of the pianos but also the pitches of the woodwinds. The pitches in the smaller editors that connect after object *12tone-diff* on the right of b1 to b6, are the rest of the pitches within the twelve-tone scale which are missing in each harmonic phrase. The fast two-note chords played on the solo violin seem to get their pitch materials from these missing pitches of the orchestra. We observe from b1 that all twelve pitches are employed in this passage of the solo violin. Two contrasting layers appear at rehearsal 114, namely the *fortissimo* chords played by the strings and the sustained soft chords played by the trumpets and trombones. The solo violin plays several short phrases that contain artificial harmonics in between the normal notes. The OM analysis in **Figure 73** displays both pitch materials of the

orchestra and solo violin. The pitches of a appear in the second and third measures of rehearsal 114, which contain five pitches (shown in a1). Even though the first chord played on the strings is a six-note chord, it is in fact a chord with three different pitch classes to form a major triad (G#, E# and C#). Note that the third chord of c is similar to the first. The brass instruments play four-note chords, which are sustained while the solo violin plays the melody. Two such chords share the same prime form of (0 1 5 6). I combine the pitches of the sustained chord 1 and the solo violin, and through object *12-tone* we observe that nine pitches excluding F G and G# are employed for the first phrase of rehearsal 114 (refer to ac1).

The second phrase, from the second beat of the third measure until the end of this figure, contains eleven pitches excluding E. The climax appears at rehearsal 115, which is marked “Ad Libitum” and contains a giant twelve-tone chord. The full chord is shown in the last chord, indicated as d in **Figure 73**. If we analyze carefully, we find that two layers combine to create the harmony here, of which the first layer consists of a chord played in the winds and the second layer consists the same chord played in the strings. The chord editor d1 displays the first chord, which consists of only the intervals 5, 4, 3 and 1. If we use Rae’s chart (please refer to **Figure 44**) to describe the structure of the chord, it consists of three four-note chords C+H+C. It is the same on strings, except the passage of the repeated materials is different.

After the climax, the solo violin begins playing a very lyrical melody, marked *appassionato*. Each phrase of the melody is accompanied with different harmony as the chords shown in f of **Figure 74**. The melody can be divided into five parts, and there are five chords that accompany it. Please refer to **Figure 74**, where I have marked the five parts of the solo violin from a to e in red on the left side of the example. The five CS editors marked from a1 to e1 on the bottom indicate the pitch materials of the melody. The progressive chords played on strings move in a

downward direction. When I use the object *compare2list-inter* to find out if the corresponding pitch materials share the same pitches, the results are blank from f1 to f4, which implies that no pitches are shared within the aggregate. The exception is that C# and E are shared in both e1 and f5, which indicate the materials of rehearsal 120.

The music at rehearsal 122 returns to metered notation marked “A Battuta”. The six-note chord played by the bassoons, trumpets, and trombone opens this last section, which is followed by the solo violin performing a fast melody *sul ponticello*. As we can see from **Figure 75**, six pitches are employed for the melodic line of the solo violin (a1). The next chord played in the strings is also a six-note chord whose pitches are shown in d2. The solo violin continues to play a melody that consists of the interval pair of 1 and 2 from the last measure of rehearsal 122. The melody can be divided into two parts. The first part is a repetition and continuation of the melody at rehearsal 122. The second part of the melody is an upward scale that spans from B3 to F6. The last chord of d indicates the harmony of the strings, which accompanies the melody of the solo violin. It is clear that the interval pair 2+3 is used for building the melodic contour on the strings.

While the woodwinds take over from the strings to play a similar texture, the strings go on to play a group of chords that are expansions of various triads. We can observe these chords in f. It is interesting to find out that only five pitches are employed, as shown in f1. Since so few pitches are employed, that means all chords belong to a single pitch set, thus the voice leading should be given more attention. We can see from f2 that the distances (intervals) of the outer voices are ic 3, 1, 4 and 5, and the last five chords have the same pitches on both voices. This leads to the very end of the piece. The pitch materials of the solo violin are quite simple. As shown in e1, we observe the seven pitches that are employed after removing repeated notes. The accents on G, D, Bb and Db are quite important which almost sound like a cadence of

the traditional and functional harmony. The Db (=C#) leads to D at rehearsal 125.

The trumpets, trombones and strings play together on a four-note chord (0 1 3 7) at the beginning of rehearsal 125. Then the orchestra plays on a major seventh of B and A# that moves from high to low registers while the solo violin plays D on different registers, serving as the third of a seventh chord. The next measure is similar to the first, but a new type of four-note chord, (0 3 4 7), is played by the bassoons, trumpets, trombones and strings. The solo violin plays B in different registers, which serves as the bass of the ninth chord when combining with the major seventh chord played on the orchestra. The piece lands on A (bass)-G# (melody) at the end. We can see that the outer voices of the harmony of the orchestra focus on the interval classes 1 and 4.

I include a graph of the analysis done by Steven Stucky. As shown in **Figure 81**, Stucky illustrates the harmonic “links” of the orchestral materials of rehearsals 94 to 107. In the note for me⁴⁰, Stucky suggested two contrasting types of music:

- a. narrow, chromatic and/or interval-paired music (beginning to 94; 95-97; 99-100; 101-102; 104-106);
- b. music based on a recurring series of triads and trichords, plus a lower and an upper layer adding up to six additional pitches (94-95, continuing 97-99; 100-101; 102-104; 106-107; 107-108).

He also indicated that:

All the b-type phrases are versions of one another; that, even more specifically, 102 is a new version of 94, while 107 is a new version of 100; and that it is their triadic basis that constitutes their essential contrast to the a-type sections. All the b-type sections are sketched on my attached page.

⁴⁰ In a letter Steven Stucky sent me on March 28, 2010, he commented on this dissertation and kindly shared with me his own analysis materials about this particular passage.

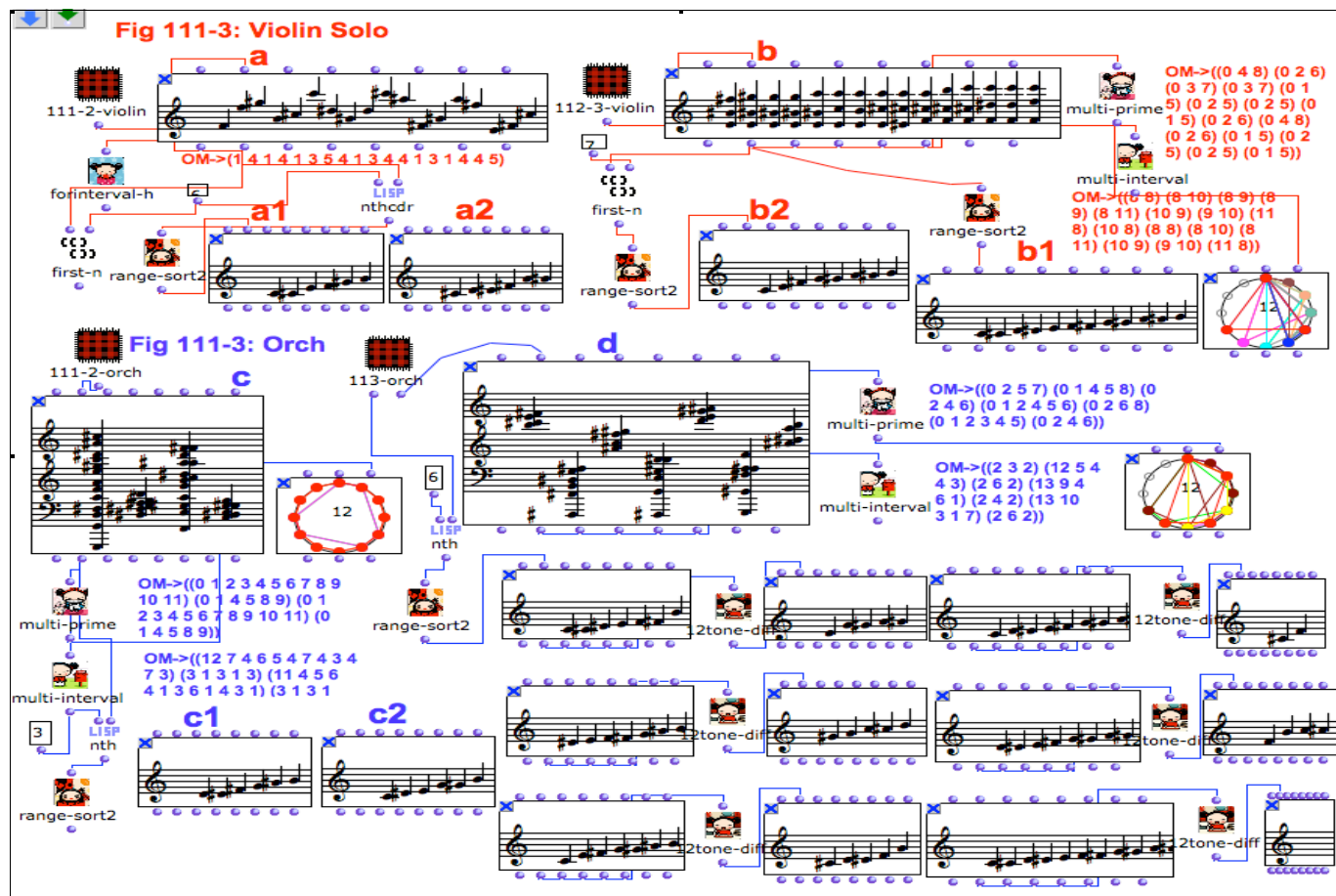


Figure 72
OM analysis of rehearsal 111-113

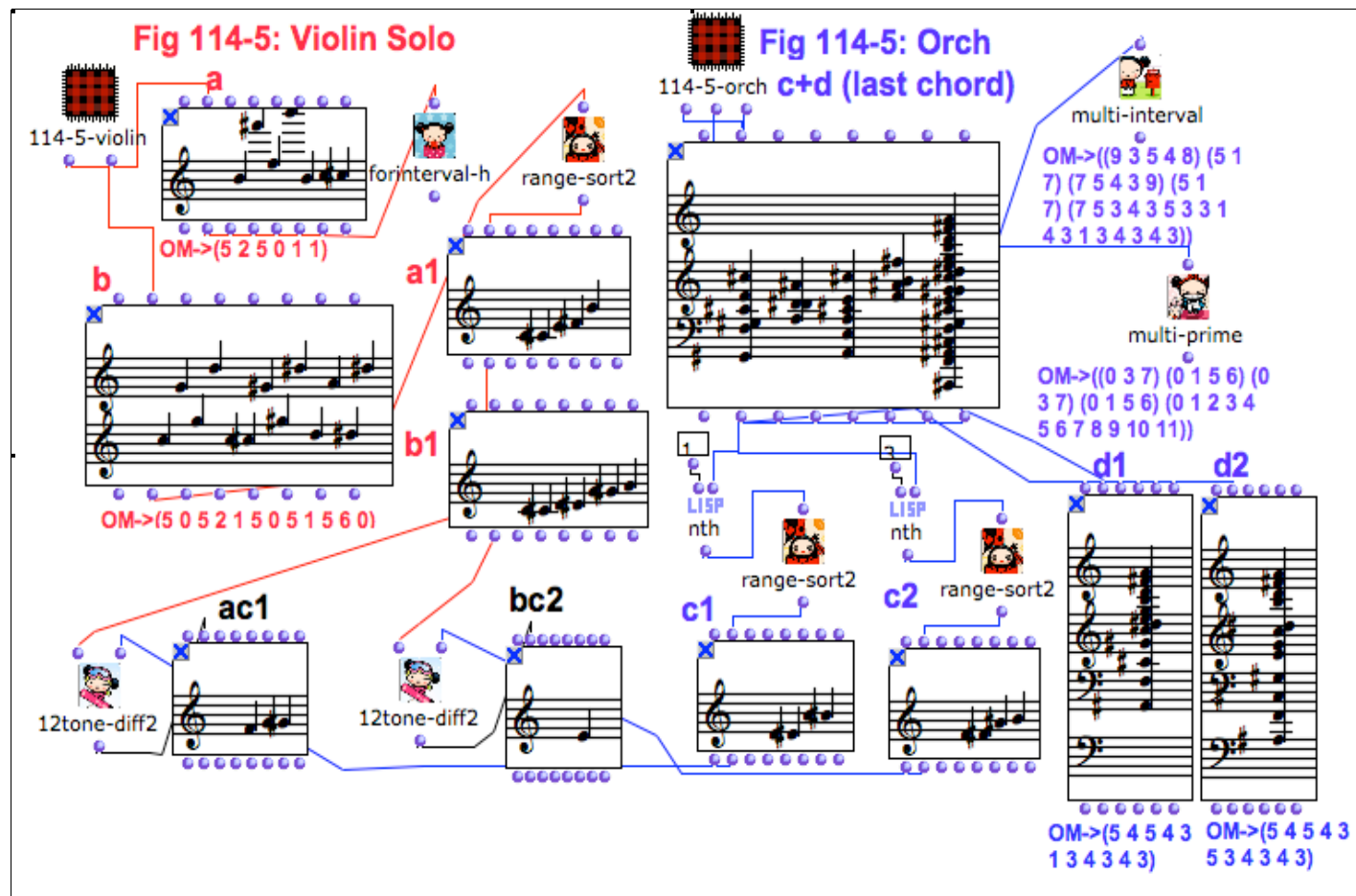


Figure 73
OM analysis of rehearsal 114-115

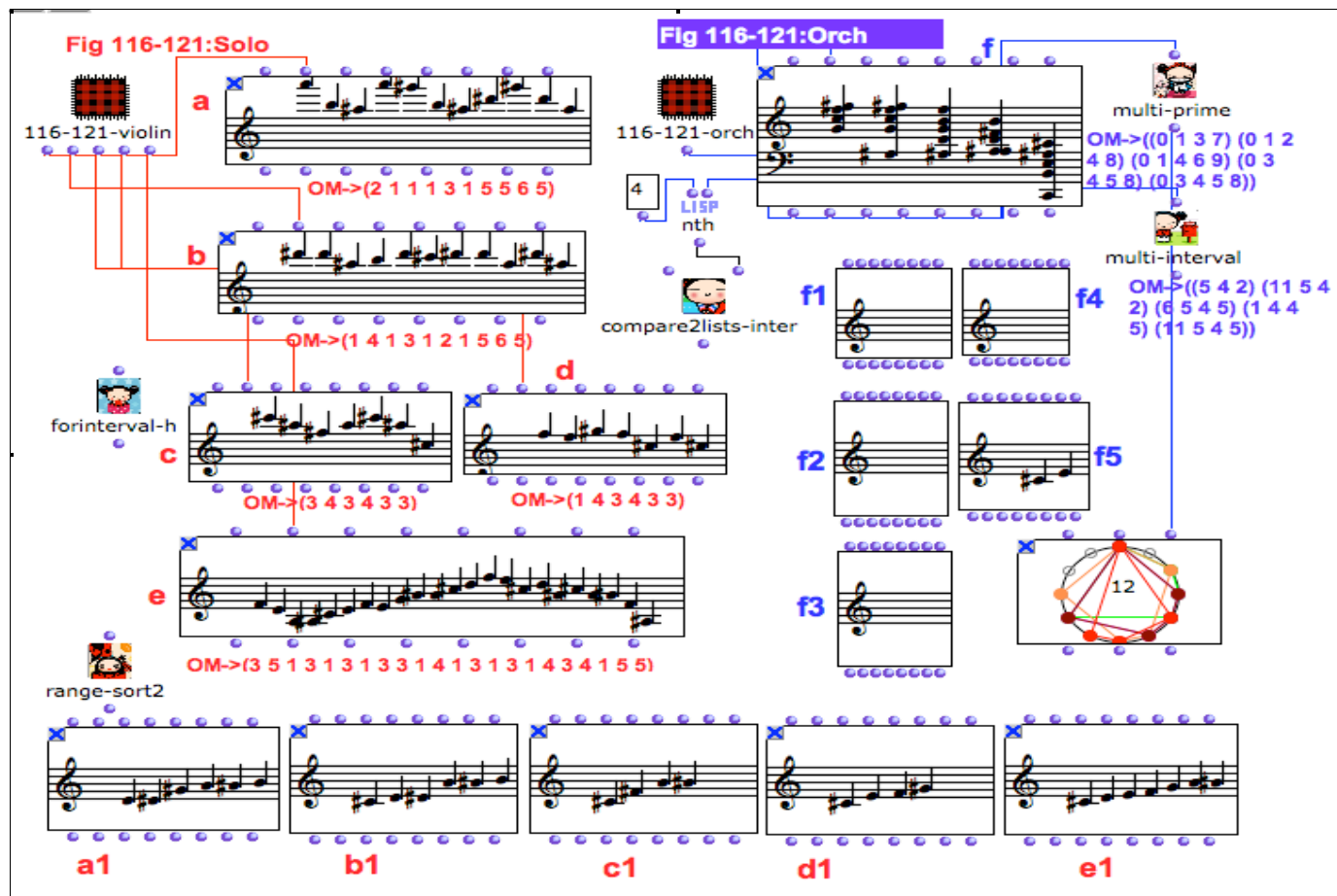


Figure 74
OM analysis of rehearsal 116-121

Figure 75
OM analysis of rehearsal 122-124

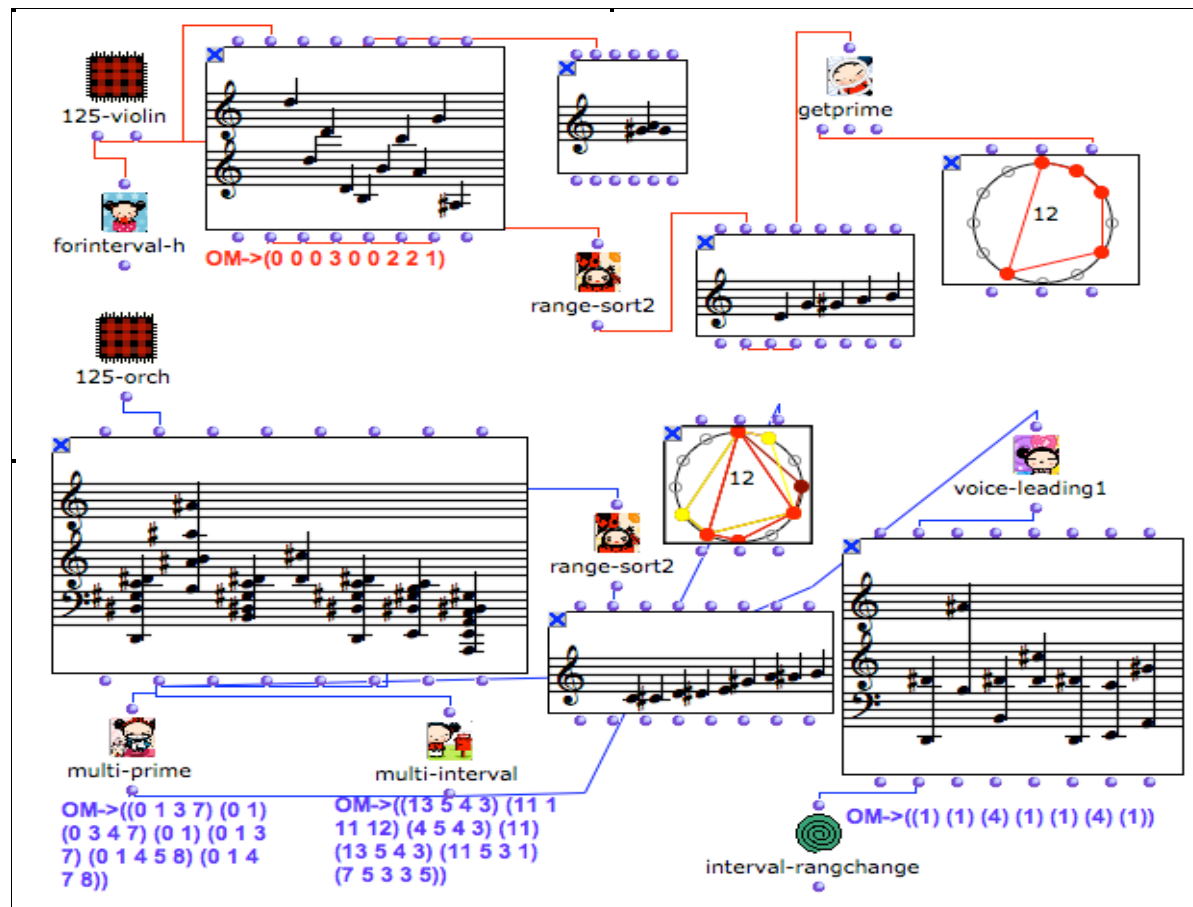


Figure 76
OM analysis of rehearsal 125

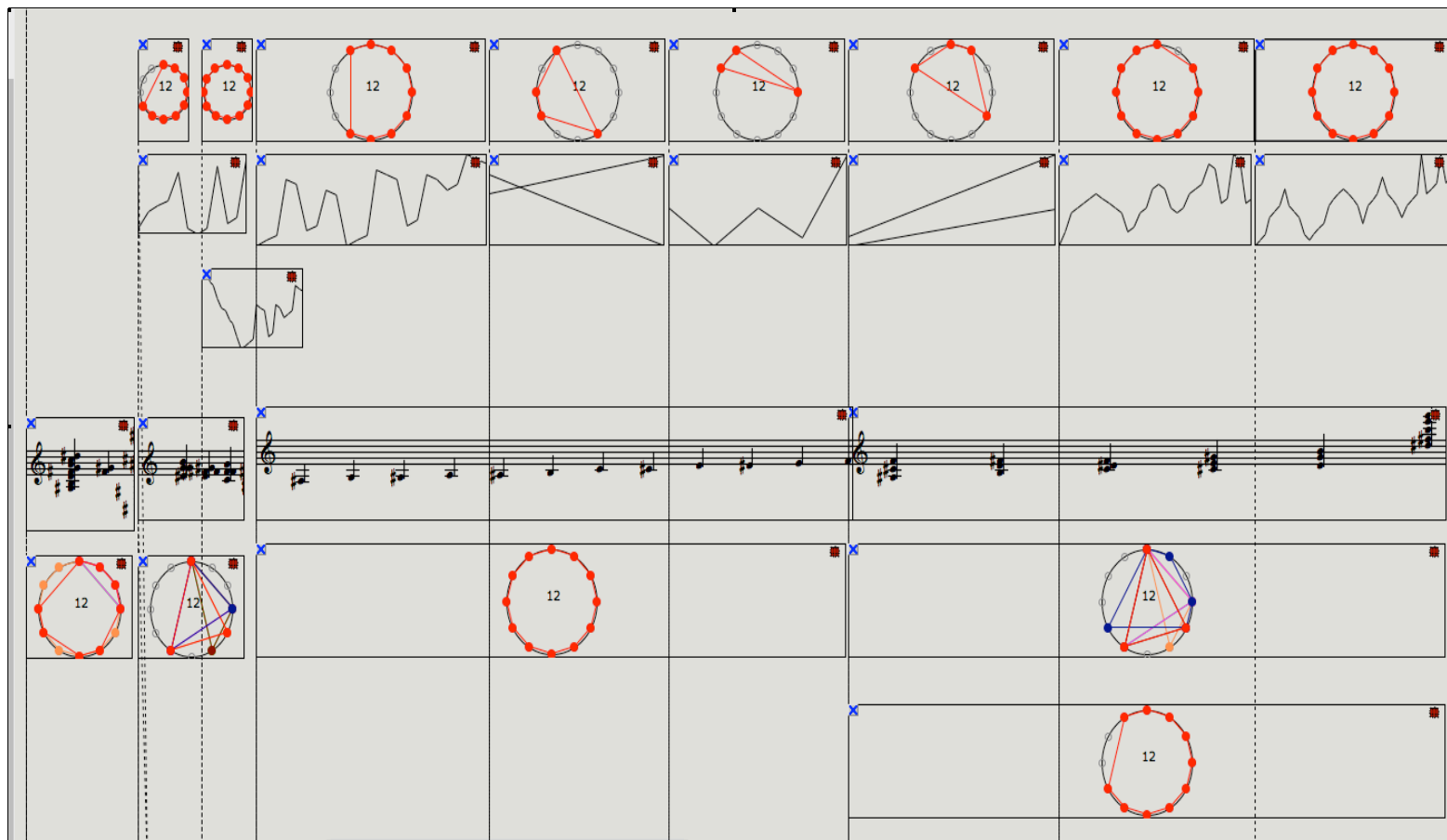


Figure 77
OM analysis of the first section of Movement IV (rehearsal 93-99)

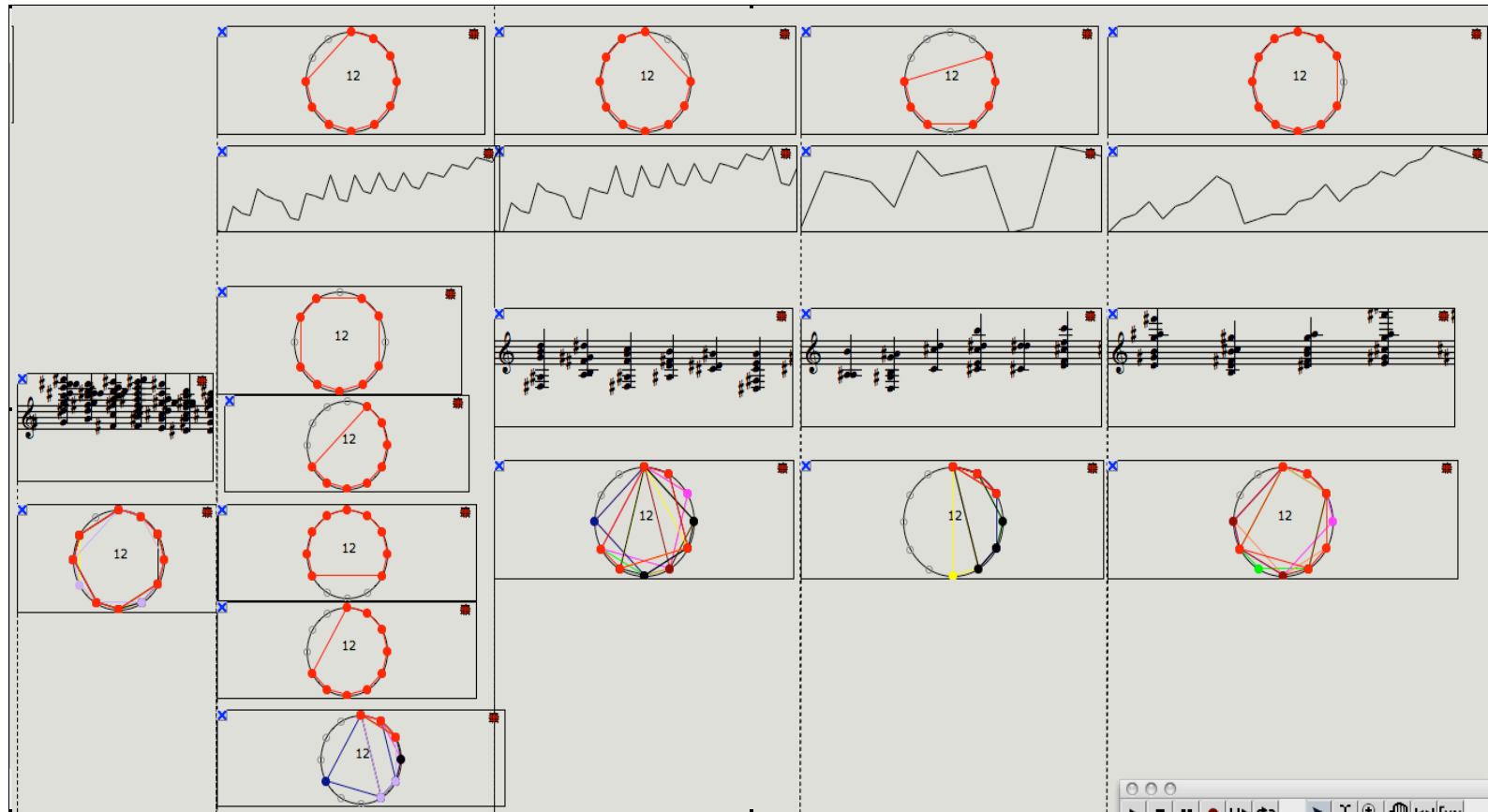


Figure 78
OM analysis of the second section of Movement IV (rehearsal 100-7)

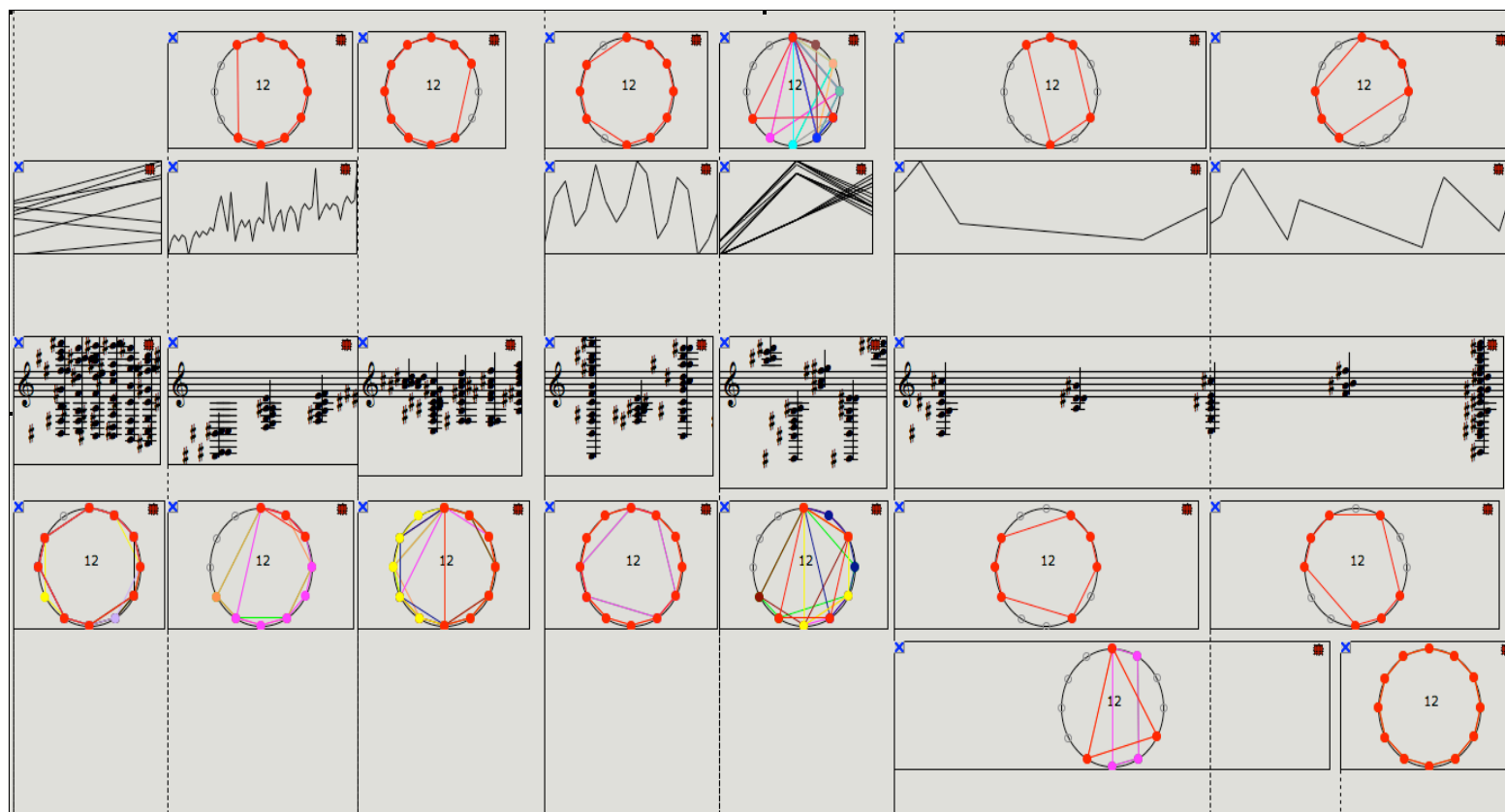


Figure 79
OM analysis of the third section of Movement IV (rehearsal 108-115)

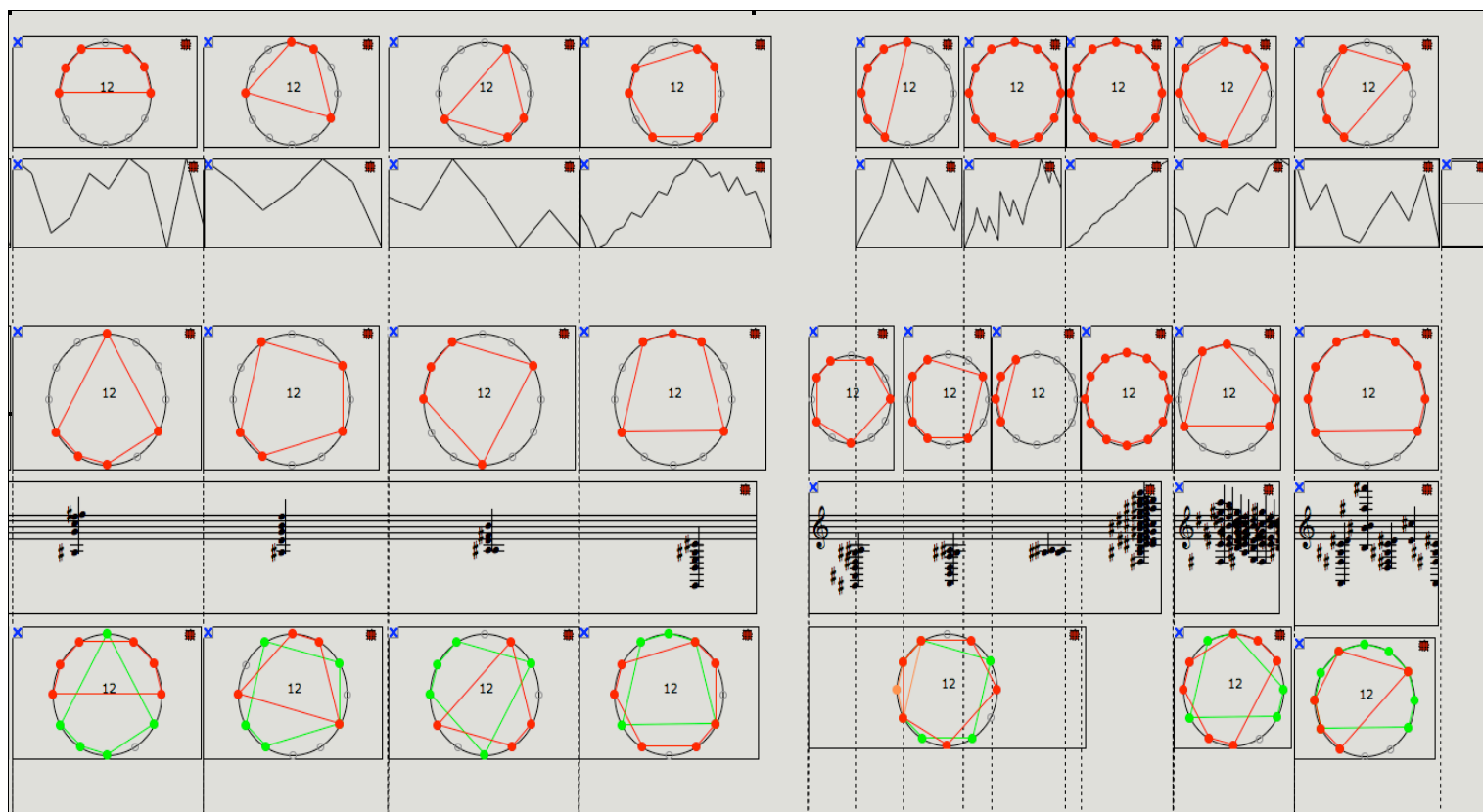


Figure 80
OM analysis of the fourth section of Movement IV (rehearsal 116-125)

Conclusion

One of the most important facts I have discovered through the analysis of Lutosławski's *Chain 2* is how this piece embraces almost all of Lutosławski's compositional techniques. It is especially worth noting his exquisite usage of materials that are often handled cautiously and frugally. His manipulation of the pitch materials is notable in this piece, which reflects several facts: the frequent use of interval pairings for composing the melodies on the solo violin; symmetrical construction of the chords for a characteristic harmonic language; chord aggregates for building the large chords; limited employment of twelve-tone chords, saving them for the climax sections; complementation of the pitch materials distributed among the solo violin and orchestra; the divided chromatic and diatonic layers on the solo violin and orchestra; allusions to classical music with frequent employment of triads and intervals of fourth and fifth applied on the bass line; and furthermore his superb planning of the pedal tones and pitch class sets. His conservative use of textural materials is also quite extraordinary: characteristic motives are briefly introduced at first and are further developed in the following movements; the use of refrains and episodes; contrasting movements with limited aleatory techniques and metered movements; isorhythmic structure and contrapuntal melodies; and finally chain techniques applied to the second movement and part of the fourth movements. In a conversation with Irina Nikolska, Lutosławski stated, "The thing that satisfies me now--in every respect--is *Chain 2*."⁴¹ He then continues, "As for other works, they always seem to me to contain something irritating." It is not necessary for us listeners of his music to agree with him; nevertheless, through the analysis of this piece, it is perhaps clear why he favors it so greatly.

During the progress of this paper, I have come across some interesting

⁴¹ Nikolska, *Conversations with Witold Lutoslawski*, 114.

information for the subject of computational music analysis within the OM environment. For instance, some external OM libraries such as the Morphologie, Musicmap, OMkanthuss, Ompitchfield, Profile, and Soal, contributed by experts from around the world, can be quite useful for different analytical purposes. The first three libraries of the list, Morphologie, Musicmap, OMkanthuss, are designed specifically for music analysis and offer valuable analytical tools. However, they do not offer detailed documentations or tutorials, and especially some information of these programs seems to be out of date, which makes the learning process quite difficult. The last three libraries, Ompitchfield, Profile, and Soal, offer detailed documentation and some good examples that are more user-friendly. Soal is a more recent program that can be useful for understanding the spatial and sonic features of a musical composition. I have adapted some of the tools for my own analytical purposes. However, I realize the limitation of this program that also appears in a number of other analysis programs, that is the presentation of the information or data is purely numeric. Such presentation requires readers to either be knowledgeable in either math or computer science, which limits the number of users.

Finally, I would like to stress that the purpose of this paper is, through the analysis of Lutosławski's *Chain 2*, to develop a keener understanding of the composer's explicit planning of materials, particularly pitch organization and form, along with his mastery of orchestration. The adaptation of computer tools in OM serves two primary purposes: one is to increase the speed and accuracy of some analytical procedures, for instance, to quickly obtain the prime forms of the pitch class sets, interval classes of a given melody or chord, comparisons of two or more sets of pitch materials, etc. The second purpose is to represent the analytical information graphically for easier access for the readers, which also helps the researcher in finding the inner relationships of the pitch and structural materials presented in a large canvas

(OM maquette editor). Note that this paper may not be viewed as innovative in technology within the field of computational music analysis, because the tools I have designed are simple and personal. Nevertheless, I hope my research could provide inspiration and encouragement for interested researchers to continue designing computer analysis tools that are useful and user-friendly. And I believe such efforts would make the analysis process more efficient and enjoyable.

Jackson Pollock once commented in an interview that “Modern Art...is nothing more than the expression of contemporary aims of the age that we’re living in... New needs need new techniques...and that each age finds its own technique.”⁴² I believe this statement is true for modern music as well as for music analysis. And I strongly believe that the bright future of computational music analysis which Jan LaRue⁴³ once imagined will eventually come true in the not-so-distant future.

⁴² O’Connor, Francis V. and Eugene Victor Thaw, eds., *Pollock: A Catalogue Raisonné 4* (New Haven: Yale University Press, 1978), 248-51.

⁴³ See page 2.

Chain 2, movement 4
Selected “links” (orchestra only)

94 95 97 98

100

102 103 104 106

107

016 016 014 016 025 015 016 025 014 016 015 016 037 016 016 036 025 016 016 015 025 037 0136 0147 0147 0147 0147 0136 0147

Figure 81
Selected “links” (orchestra only) by Steven Stucky

APPENDIX

Style Periods	Notable Features	Principal Works
Early (1934-1955)	Neo-classic, tonal, adaptation of Polish folk materials	<i>Lacrimosa</i> (1937) <i>Symphonic Variations</i> (1936-8) <i>Paganini Variations</i> (1941) Symphony No.1 (1941-7) <i>Overture for Strings</i> (1949) <i>Concerto for Orchestra</i> (1950-4) <i>Dance Preludes</i> (1954; 1955; 1959)
Middle (1956-1979)	Abandon folklore Twelve-note chords Complex harmony Limited aleatory	<i>Illakowicz Songs</i> (1956-7) <i>Musique funèbre</i> (1954-8) <i>Three Postludes</i> (1958-60) <i>Jeux vénitiens</i> (1979) <i>Trois poemes d'Henri Michaux</i> (1961-3) String Quartet (1964) <i>Paroles tissees</i> (1965) Symphony No. 2 (1965-7) <i>Livre pour orchestre</i> (1968) Cello Concerto (1969-70) Preludes and Fugue (1970-2) <i>Les Espaces du sommeil</i> (1975) <i>Mi-parti</i> (1975-6) <i>Novelette</i> (1979)
Late (1979-94)	Simplified harmony Melody emphasis Reduced deployment of the <i>Ad Libitum</i> sections	<i>Epitaph</i> (1979) Double Concerto (1979-80) <i>Grave</i> (1981; 1982) Symphony No. 3 (1972-83) Chain 1 (1983) Partita (1984; 1988) Chain 2 (1984-5) Chain 3 (1986) Piano Concerto (1987-8) <i>Chantefleurs et Chantefables</i> (1989-90) Symphony No. 4 (1988-92) <i>Subito</i> (1992)

Table I: Lutosławski's Three Style Periods

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